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A Critical Study of the Accuracy of Dye-Testing Vat Dyestuffs for Strength*

Experimental Method and Calculation of Data—Method of Finding Deviation of Test—Variations in Results—Discussion of Results—Accuracy Not Influenced by Experience —Effects of Different Colors

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THE increasing demand for very fast colors by the textile industry makes the accurate standardization of vat dyestuffs for strength of increasingly greater importance to both the dye manufacturer and the dyer. Although the experienced dye tester intuitively realizes the limitations of his methods, no statistical study has yet been published showing how accurately the strengths of vat dyes may be determined by laboratory dyeings or how closely different observers may agree as to the strengths of samples which differ more or less widely from each other in dyeing hue.

A knowledge of the precision of the usual method is important not only because it leads to an appreciation of how closely vat dyestuffs may be standardized for strength commercially but also because such a knowledge is fundamentally requisite for a study of how accurately the several parts of the dye-test procedure, such as the weighing of the skins and samples, etc., need be carried out in order to attain the best precision possible without an unnecessary waste of time and care. Furthermore, any special technique and apparatus for the careful control of temperatures and concentrations such as were suggested by Appel[1] for dyeing wool with acid colors will receive serious attention in practical work only when it has been shown that the average deviation of a determination using the more costly method is appreciably less than that of the present practice. Likewise, any optical instrument for the examination of dyed skeins similar to the device constructed by Professor Pfund, of Johns Hopkins University, must prove its worth by decidedly bettering the accuracy which can be attained in less time with the unaided eye.

The present paper is presented to show with just what precision the strength of a vat dyestuff can be ascertained under the usual routine laboratory conditions. An attempt has been made to obtain from the results of scores of dyeings of four representative anthraquinone vat dyes a value for the average deviation of successive independent determinations of dyeing strength which truly represents what should be expected in commercial practice. The paper will also show to what extent different observers may differ in their appraisal of the dyeing strength of samples varying in dyeing hue or shade.

Experimental Methods and Calculation of Data

Although by far the greater portion of the vat color manufactured is marketed in paste form, in this investigation only powder samples have been employed in order to avoid any question with regard to the possibility of the evaporation of moisture from paste samples. The permanent standards against which the various powder samples were dyed are also in powder form. Samples representing the greatest difference in the finished product obtained during the regular manufacture of the following dyestuffs were used: Ponsol Yellow G (C. I. No. 1118), Ponsol Blue BCS (C. I. No. 1114) and Ponsol Blue GD (C. I. No. 1113). The standard for Ponsol Violet RRD (C. I. No. 1104) has also been dyed as an unknown against itself.

As for the methods of dyeing, those in daily use in this laboratory have been followed without modification or special precaution by persons who do nothing else but this type of work. Briefly, the vat colors given above are dyed as follows: A directly weighed sample of the dye powder is pasted with 8 c.c. of 31 deg. Be.

*Presented before the Division of Dye Chemistry at the seventy-third meeting of the American Chemical Society, Richmond, Va., April 11 to 16, 1927.

[1] Appel, American Dyestuff Reporter, 13, 507 (1924).

caustic soda, diluted with water to 50 c.c. (except the Blue GD, which is reduced in a volume of 200 c.c.), heated to the reduction temperature in a water bath and reduced by stirring occasionally during fifteen minutes with an addition of 1.5 g. of sodium hydrosulphite. Then the dye liquor is diluted to 400 c.c. and after five minutes the two-ply unbleached 20-gram cotton skein is entered. The latter has been boiled out previously for an hour with 2 per cent of soda ash and 1 per cent of Turkey Red oil calculated on the weight of the yarn. Dyeing is continued for forty-five minutes at the same temperature as is used for reduction (see tables) and with just enough turning of the skeins to insure levelness. The skein is then wrung twice, oxidized on a pole for fifteen minutes, washed in hot water, soured in a very dilute cold sulphuric acid solution, soaped for fifteen minutes at the boil with 2 per cent of soap on the weight of the fiber, rinsed well again and dried. Before the final soaping dyeings of Ponsol Yellow G are treated in a special oxidizing bath with ½ per cent of sodium dichromate on the weight of the yarn. In this work one set of dyeings never contained more than ten skeins, including three dyed with the standard and only one skein for each unknown sample.

Method of Finding Deviation of Test

In order to find the average deviation of any analytical process a method must be devised of obtaining successive determinations which are independent of each other, and which vary in such a way that the average variation from the mean will truly give the average deviation. The method of fulfilling these conditions which has been applied in this paper follows necessarily from the nature of the mechanism by which dyeing strengths are determined. However, the method is so foreign to the dyer's usual practice that it will be necessary to explain in detail why there probably can be no other way to proceed in finding the average deviation of the dye test.*

Let us assume for a moment that we have a sample of dyestuff which is stronger than standard. The standard, let us say, is dyed at 0.9, 1 and 1.1 per cent. calculated from the ratio of the weight of color to the weight of the yarn. Suppose that the 1 per cent dyeing of the sample is stronger, or appears dyed more heavily, than the 1 per cent dyeing of the standard and weaker than the 1.1 per cent dyeing. The usual procedure is now to repeat the set of dyeings with the standard at 0.95, 1.0 and 1.05 per cent and the sample at 0.95 per cent. If the 0.95 per cent dyeing of the sample matches the 1.0 per cent dyeing of the standard it may be said that 95 parts of sample are equivalent to 100 of standard. If this needs additional verification, another set of both standard and sample is dyed at the same percentages. If again the 0.95 per cent dyeing of the sample matches the 1.0 per cent dyeing of the standard the first values are said to have been checked and the work is not continued farther. If more sets are run in the same way the same results will likely be obtained and the apparent average deviation of the determinations has been zero. And yet, instead of being exactly 95, the true value for the number of parts which equal 100 of standard may well be 93.5, or some other close figure, and consequently the average deviation at least 1.5 parts in 100.

A conclusion that the average deviation for any analytical procedure is zero is obviously unsound. Such a conclusion for the dye test likewise would be without foundation because any dyer will readily admit that he cannot see 1 per cent differences in strength. It is said that the human eye can detect differences in the intensity of two uniformly lighted fields of 0.8 part in 100.[2]

But with skeins the situation is much more complicated as a difference in the strength of two dyeings is accompanied by slight changes in the total character of the light reflected from the skeins, or as the physicist would express it, by slight differences in hue, saturation and brilliance. It is not probable, therefore, that differences of much less than 2 per cent of the total in the strengths of two dyeings can be distinguished definitely with the eye.[3]

In order to obviate the obtaining of an apparent average deviation of zero in the dye test it becomes necessary to dye the unknown at a different percentage in each succeeding set of dyeings. Further, in order to fulfill the condition that each determination shall be independent of previous determinations the observer making the judgment of dyeing strength must not know what judgment will give the same results as were reported in his earlier experiences with the same sample. No matter how honest the dye tester, he is sure to be influenced unconsciously by a knowledge of any of his previous judgments.

Variations in Results

But if the dye tester is confronted with skeins of the unknown bearing only a code number, and if these skeins have been dyed at varying percentages from set to set within the limits of the three standards, he necessarily can give only a judgment for each skein which is quite uninfluenced by any of his ideas respecting the sample. Consequently each set of dyeings with its one unknown skein and three labeled standards serves as an absolutely independent determination, and the conditions given above for finding the average deviation of any method of testing are satisfied.

To illustrate in detail just how we carried out this mechanism of varying the percentage at which an un-

*The most probable value of any quantity is the average of the values obtained from several independent determinations. By average deviation is meant the average numerical difference between the single determinations and the mean or average of all of them. For a simple treatment of the whole subject of errors see "Precision of Measurements and Graphical Methods," by H. M. Goodwin, McGraw Hill, 1920.

[2] Int. Crit. Tables, Vol. 1, p. 93.

[3] W. H. Watkins, J. Ind. Eng. Chem., 11, 1079 (1919).

known is dyed and of submitting only coded skeins to the colorist for examination we present Table I, containing the complete data for Sample No. 2 of Ponsol Blue GD Double Powder. Here we find Observer A, when given a skein dyed with the unknown at 3.7 per cent on the weight of the fiber but bearing on its label only the code number "Sample 2—Set 1," estimated that the depth of this dyeing was exactly equal to the 4.0 per cent dyeing of the standard. With these figures we calculate from this determination that 92.5 parts of sample are equivalent to 100 of standard. Observer B, on the other hand, found this same first skein to be dyed heavier than the 4.0 per cent and weaker than the 4.2 per cent dyeing of the standard in this first set, or equal, by interpolation, to a 4.1 per cent dyeing of standard. The latter judgment gives the value 90.2 for the number of parts equal to 100 of standard.

By taking the average of results obtained in this manner from ten successive independent sets of dyeings, each containing one skein dyed with the unknown at from 3.5 to 4.0 per cent, we arrive at a value for the sample of 92.8 from the judgments of Observer A and 93.1 from the work of Observer B. In the fifth and eighth columns of the table are shown the deviations, with their proper sign, of the value for each determination from the average of all of them for that sample. At the bottom of the fifth column for Observer A and of the eighth column for Observer B, appear the averages of these deviations from the mean.

This method of presenting unlabeled skeins dyed with an unknown for judgments of strength has been used in obtaining all the data for this work. The same sets of dyeings for a given sample were submitted to several observers, and the results were calculated in the manner described above. In the proper column opposite any observer in each of the tables are given both the average value for the number of parts found equal to 100 of standard and the average deviation from the mean with which that quantity has been determined according to the particular observations in question. In Tables V to VIII, inclusive, the standard was treated as if it were an unknown and was dyed against itself. Since 100 parts of standard as an unknown sample obviously must equal 100 parts of standard as standard, any figure given in the third column of these four tables is an average deviation from 100 and therefore must be called an "average error."

Discussion of Results

The work reported in this paper was undertaken to find out the average deviation of determinations of the dyeing strengths of vat colors by the dye test. It is evident at once from the data, however, that the accuracy of the dye test varies widely from time to time and from sample to sample for even the same observer with dyeings made by the same operator. For example, in Table II Observer A estimated the strength of sample 9 with an average deviation of 1.4 parts in 100, but the strength of sample 3 with an average deviation of 5.2 parts in 89.6. The best we can hope for is to obtain an approximate idea of the range of accuracy of the dye test as a guide to an appreciation of the method. The results of the observations of many dyers upon hundreds of dyeings of a large number of samples would be necessary to obtain a statistical and general single value for the average deviation of a determination of dyeing strength which would represent the average accuracy under *all* circumstances. But since the accuracy does vary so widely with different observers and different samples, perhaps the assignment of any single value to the precision measure of the quantity we seek would not emphasize the accuracy which ought to be demanded from a very expert observer under the good conditions usually obtaining in a standardizing laboratory.

Tables II, III and IV show what really remarkable results can be obtained in estimating the strength of the anthraquinone vat dyes. Using sixty-seven independent sets of dyeings, Observer B estimated the strengths of ten samples of Ponsol Blue BCS Powder varying more or less widely in dyeing hue with an average deviation of 2.2 parts in 100. With Ponsol Blue GD Double Powder and with Ponsol Yellow G Double Powder the accuracy was better, the average deviation being only 1.4 parts in 100 for the first and 1.9 parts in 100 for the second. For

TABLE I

Detailed results from successive determinations of dyeing strength of sample No. 2, Ponsol Blue GD Double Powder:

BY OBSERVER A

Set No.	Dyeing of Sample	Judged Equal to Standard	Parts of Sample Equal to 100 of Std.	Dev. from Mean
1	3.7%	4.0%	92.5	—0.3
2	3.7%	4.2%	88.1	*—4.7
3	3.5%	3.8%	92.1	—0.7
4	4.0%	4.2%	95.3	+2.5
5	3.6%	3.8%	94.7	+1.9
6	3.9%	4.2%	92.9	+0.1
7	3.9%	4.1%	95.1	+2.3
8	3.8%	4.2%	90.5	—2.3
9	3.7%	3.9%	94.9	+2.1
10	3.6%	3.9%	92.3	—0.5
	Average or mean.....		92.8	1.7

BY OBSERVER B

1	3.7%	4.1%	90.2	—2.9
2	3.7%	3.9%	94.9	+1.8
3	3.5%	3.8%	92.1	—1.0
4	4.0%	4.2%	95.3	+2.2
5	3.6%	3.8%	94.7	+1.6
6	3.9%	4.2%	92.9	—0.2
7	3.9%	4.1%	95.1	+2.0
8	3.8%	4.1%	92.7	—0.4
9	3.7%	4.2%	88.1	*—5.0
10	3.6%	3.8%	94.7	+1.6
	Average or mean.....		93.1	1.9

*Maximum deviation from the mean.

Dyeing hue of sample versus standard—trace red and dull.

Each set contained skeins dyed with standard at 3.8, 4.0 and 4.2% for comparison.

Reducing and dyeing temperature 49° C. (120° F.).

the whole work in these tables representing twenty-six samples and 166 independent sets of dyeings, this Observer's average deviation was 1.9 parts in 100.*

It is therefore reasonable to say that by exercising moderate care in the weighing of skeins and samples and in the dyeing and examination of skeins the strength of a vat color can be estimated with an average deviation of about 2 parts in 100. By care in examining skeins we mean repeatedly comparing the standards and unknown skeins each day seemed able to make their judgments in the shorter time. It should not be necessary to point out that the standardizing of dyestuffs requires much more from a dye tester than a mere ability to make strength comparisons. In other words, intimate experience in the uses and dyeing properties of scores of products is needed to turn out uniform lots of material which will satisfy the trade.

It must be emphasized again that in this investigation

TABLE II

Average Deviation of Determinations of Dyeing Strength of Ponsol Blue BCS Powder

Sample No.	No. of Sets	Dyeing Hue vs. Std.	OBSERVER A — Parts Equal to 100 of Std.	OBSERVER A — Ave. Dev.	OBSERVER A — Max. Dev.	OBSERVER B — Parts Equal to 100 of Std.	OBSERVER B — Ave. Dev.	OBSERVER B — Max. Dev.	Dif.
1	6	Sli. green	106.7	3.4	6.7	109.3	2.3	4.0	2.6
2	10	Sli. green and dull	107.8	4.2	8.9	108.2	4.4	8.7	0.4
3	7	Tr. red	89.6	5.2	10.4	87.3	2.3	4.8	2.3
4	6	Sli. green	96.8	2.7	6.3	95.3	0.8	1.3	1.5
5	1	Green	117.2	2.2	3.3	121.3	1.3	2.6	4.1
6	6	Sli. green	99.6	1.6	4.6	100.6	1.3	2.3	1.0
7	5	Sli. green	91.0	2.3	4.6	90.5	1.3	2.1	0.5
8	5	Sli. green	94.1	1.6	3.2	96.9	1.8	3.9	2.8
9	6	Sli. green	100.4	1.4	2.9	104.6	1.8	3.7	4.2
10	10	Green and dull	115.0	4.7	12.8	115.2	4.5	10.9	0.2
Average			101.8	2.9		102.9	2.2		2.0

Standards dyed at 1.8, 2.0 and 2.2 per cent.
Reducing and dyeing temperature 60 deg. Cent. (140 deg. Fahr.).

in a set at different angles in good north daylight, each viewing of the skeins lasting not over approximately five seconds so as to avoid eye fatigue.

All people are not equally expert, or at least not equally careful in estimating dyeing strengths. The results given in Tables V to XII, inclusive, show how widely several dyers vary in the accuracy with which they can arrive at a final result according to our special method. By way of illustration we see that Observer A estimated the strength of Sample 2 of Ponsol Blue Double Powder (Table XI) with an average deviation of 1.7, but Observer D arrived at his final result for the same sample with an average deviation of 4.4. If we use all the results of Tables V to VII, inclusive, we can calculate that the average deviation for all the observers in testing all these samples was 3.5 parts in 100.

Accuracy Not Influenced by Experience

There was apparently no correlation for the men whose work has been followed in this paper between their accuracies in judging strengths and their years of experience in the dye business. It is my belief that the ability to compare skeins for strength is rather a function of the natural visual powers of any person for distinguishing color and of the care with which he makes his decisions However, the men who are examining the most dyed all the judgments for any one sample were made by the several observers on the same skeins. Occasionally a person would object that the dyeings were uneven and dirty. As a matter of fact, the dyeings represented our usual work and were quite satisfactory. Occasionally an observer who objected most to the levelness of the dyeings or the cleanness of the skeins would come out in the end with the best precision. Furthermore, Observer C, who consistently obtained the poorest results, was always only the second to make his judgments while Observer B was the third or fourth. The objections of these few were perhaps only a natural defense reaction called forth by having to put their ability as dye testers on trial. Since the dyestuffs which have been considered in this investi-

*In calculating the final average deviations for the observers in Tables II, III and IV, the average deviation for each sample was given equal weight regardless of the number of sets for the sample.

TABLE III

Average deviation of determinations of dyeing strength of Ponsol Blue GD Double Powder:

Sample No.	No. of Sets	Dyeing Hue vs. Standard	OBSERVER B — Parts Equal to 100 of Std.	OBSERVER B — Ave. Dev.	OBSERVER B — Max. Dev.
1	6	Red	97.2	1.4	2.8
2	10	Tr. red	93.1	1.9	4.9
3	6	O. K. tr. green	98.8	0.9	2.6
4	6	O. K. tr. green	97.2	1.7	3.1
5	6	O. K.	96.7	0.9	1.5
6	6	O. K.	99.7	2.3	4.0
7	6	O. K.	100.9	0.8	1.5
8	6	O. K. tr. red	101.7	1.0	1.7
Average			98.2	1.4	2.8

Standards dyed at 3.8, 4.0 and 4.2%.
Reducing and dyeing temperature 49° C. (120° F.).

gation are so very stable and since the dyed skeins were kept in closed boxes while not in use, there must have been very little change in any skein during the time elapsing between the judgments of the first and last observers.

An interesting point in connection with a study of dye testing is the problem of finding where in the different parts of the whole procedure the greatest error occurs. The average deviation in the weights of samples and in the weights of skeins can be easily made so small as not to affect the accuracy of the final result. There remains the task of determining which is of greater consequence, the variation in the proportion of color substance which is precipitated in the fiber or the error in the judgment of the colorist. If the former, the variation in relative exhaust, were distinctly the predominant feature affecting the accuracy of strength determinations, the maximum deviations for all observers would nearly always occur with the same skein. In the work we are reporting the maximum deviations for any two observers occurred with the same skein only about half the time, or about 7.5 times more often than one would expect.

The question is often raised in discussions about dye testing whether some colors are not harder to judge than others. Our work shows that there can be at least no marked difference in the accuracy with which the strengths of blues, yellows, and violets can be estimated as the same range of precision was obtained for all of them. It may be added that data from some of our work with other classes of dyestuffs have seemed to show the same thing. Such a conclusion, however, may not conform to the ideas of many people who have had experience in this line, but who may not have made a numerical study of this question. For example, some dyers think they have difficulty with yellows. But the eye is very sensitive to slight changes in the hue and brightness of a yellow and it is possible that this sensitivity may annoy an observer without necessarily decreasing the accuracy with which he can make strength comparisons.

The effect of the magnitude of the differences between the three standard skeins in each set on the accuracy of dye testing could well receive further study. In the work with Ponsol Blue GD Double Powder in Table II where the differences between the standards were 5 per cent of the total amount of dyestuff, the average deviation of strength judgments by Observer B was appreciably less than for the determinations in Tables II and IV where 10 per cent differences between standards were employed.

A difference in dyeing hue, or shade, between an unknown and its standard does not seem to make any one observer appreciably less consistent in his own judgments of dyeing strength. In other words, the average deviation of successive judgments by a single person is apparently about as small for samples which are quite like standard and are therefore termed O. K. as for samples which are distinctly off shade.

TABLE IV

Average Deviation of Determinations of Dyeing Strength of Ponsol Yellow G Double Powder

Sample No.	No. of Sets	Dyeing Hue vs. Std.	OBSERVER A — Parts Equal to 100 of Std.	OBSERVER A — Ave. Dev.	OBSERVER A — Max. Dev.	OBSERVER B — Parts Equal to 100 of Std.	OBSERVER B — Ave. Dev.	OBSERVER B — Max. Dev.	Dif.
1	6	Sli. red	96.6	1.2	2.4	95.7	2.4	5.7	0.9
2	6	Tr. red	97.0	2.8	5.2	95.4	3.9	6.1	1.6
3	6	Tr. red and dull	99.3	2.1	3.5	98.2	3.5	6.5	1.1
4	6	Tr. red and dull	96.9	3.2	5.3	95.4	4.7	9.4	1.5
5	5	O. K. sli. dull	91.1	1.3	2.8	92.6	1.6	3.2	1.5
6	6	Tr. red and dull	99.6	1.1	2.3	99.7	1.7	3.6	0.1
7	6	O. K.	94.1	1.5	3.7	97.9	2.9	4.4	3.8
8	6	Tr. dull	97.8	1.6	2.2	102.5	2.5	4.5	4.7
Average			96.7	1.9	3.4	96.2	2.9	5.4	1.9

Standards dyed at 2.25, 2.50 and 2.75 per cent.
Reducing and dyeing temperature 54 deg. Cent. (130 deg. Fahr.).

TABLE V

Errors in judgment of different observers with regard to strength of Ponsol Violet RRD Standard when dye-tested against itself as an unknown:

Observer	Parts Equal to 100 of Std.	Ave. Error	Max. Error
A	101.4	1.8	3.2
B	101.4	1.9	4.3
C	101.9	4.9	12.6
D	101.5	4.6	13.6
E	100.1	5.0	8.9
F	102.7	4.3	11.1
Average	101.5	3.8	

Standards in each set dyed at 1.8, 2.0 and 2.2%.
Number of sets—10.
Reducing and dyeing temperature—60° C. (140° F.).
Dyeing hue versus standard—identical.

TABLE VI

Errors in judgment of different observers with regard to strength of Ponsol Blue BCS Powder Standard when dye-tested against itself as an unknown:

Observer	Parts Equal to 100 of Std.	Ave. Error	Max. Error
A	100.1	3.1	11.1
B	100.9	1.8	4.9
C	99.4	2.0	5.0
E	99.7	2.8	9.5
Average	100.0	2.4	

Standards in each set dyed at 1.8, 2.0 and 2.2%.
Number of sets—11.
Reducing and dyeing temperature—60° C. (140° F.).
Dyeing hue versus standard—identical.

Although a difference in hue between a sample and its standard may not make it more difficult for an observer to arrive at a dyeing strength which is satisfactorily to his judgment, such a difference does affect the agreement in the average values for dyeing strength obtained by different people. The most striking example of disagreement we have encountered in the work of any two colorists using the same skeins for estimating the tinctorial value of a sample is that furnished by Sample 9 of Ponsol Yellow G Double Powder in Table XII. Observer E, interpreting the redness of this yellow as strength, found Sample 9 nearly 7 per cent stronger than did Observer D, who leaned over backwards in avoiding this tendency. Dulness may likewise be cause for disagreement in the strength of dyestuffs. In Table IV

TABLE VII

Errors in judgment of different observers with regard to strength of Ponsol Blue GD Double Powder Standard when dye-tested against itself as unknown:

Observer	Parts Equal to 100 of Std.	Ave. Error	Max. Error
A	101.2	2.0	5.1
B	99.8	2.0	5.1
C	100.5	3.6	11.7
D	102.9	3.9	20.2
E	101.5	3.1	12.1
F	100.6	2.2	8.2
Average	101.1	2.8	

Standards in each set dyed at 3.8, 4.0 and 4.2%.
Number of sets—12.
Reducing and dyeing temperature—54° C. (130° F.).
Dyeing hue versus standard—identical.

TABLE VIII

Errors in judgment of different observers with regard to strength of Ponsol Yellow G Double Powder, Standard, when dye-tested against itself as an unknown:

Observer	Parts Equal to 100 of Std.	Ave. Error	Max. Error
A	101.7	4.1	8.0
B	99.4	2.0	5.7
C	100.6	4.7	10.7
D	103.2	4.4	7.5
E	99.9	2.9	6.7
Average	100.8	3.6	

Standards in each set dyed at 2.25, 2.50 and 2.75%.
Number of sets—11.
Reducing and dyeing temperature—54° C. (130° F.).
Dyeing hue versus standard—identical.

TABLE IX

Deviations in judgment among several observers with regard to the strength of sample No. 2, Ponsol Blue BCS Powder, by dye test:

Observer	Parts Equal to 100 of Std.	Ave. Dev.	Max. Dev.
A	107.8	4.2	8.9
B	108.2	4.4	8.7
C	106.0	4.7	10.9
E	105.1	4.6	13.1
Average	106.8	4.5	

Standards in each set dyed at 4.5, 5.0 and 5.5%.
Number of sets—10.
Dyeing hue versus standard—slightly green and dull.

TABLE X

Deviations in judgment among several observers with regard to the strength of sample No. 10, Ponsol Blue BCS Powder, by dye test:

Observer	Parts Equal to 100 of Std.	Ave. Dev.	Max. Dev.
A	115.0	4.7	12.8
B	115.2	4.5	10.9
C	114.6	6.3	14.9
E	112.5	5.3	10.3
Average	114.3	5.2	

Standards in each set dyed at 4.5, 5.0 and 5.5%.
Number of sets—10.
Dyeing hue versus standard—green and dull.

TABLE XI

Deviations in judgment among several observers with regard to the strength of sample No. 2, Ponsol Blue GD Double Powder, by dye test:

Observer	Parts Equal to 100 of Std.	Ave. Dev.	Max. Dev.
A	92.8	1.7	4.7
B	93.1	1.9	5.0
C	92.0	3.0	8.0
D	94.2	4.4	8.4
E	93.4	1.5	4.1
F	91.5	2.5	4.9
Average	92.8	2.5	5.9

Standards in each set dyed at 3.8, 4.0 and 4.2%.
Number of sets—10.
Dyeing hue versus standard—trace red and dull.

TABLE XII

Deviations in judgment among several observers with regard to the strength of sample No. 9, Ponsol Yellow G Double Powder, by dye test:

Observer	Parts Equal to 100 of Std.	Ave. Dev.	Max. Dev.
A	102.1	4.0	11.5
B	102.3	2.7	5.5
C	100.7	5.2	12.9
D	106.1	3.1	5.0
E	99.2	2.3	7.0
Average	102.1	3.5	

Standards in each set dyed at 2.25, 2.5 and 2.75%.
Number of sets—9
Dyeing hue versus standard—slightly red.

Observers B and H differed by 4.7 per cent in their estimates of the strength of a sample of yellow which is a trace dull. Usually, however, the agreement between the several dye testers was very good. The average difference between the final mean values for the strengths of off shade samples as estimated by any two observers was less than 2 parts in 100.

From a consideration of the accuracy in the determination of dyeing strengths attained in this investigation under conditions of commercial practice, it may be pointed out in conclusion that the manufacturer should be able to standardize lots of anthraquinone vat dyestuffs very closely for strength. Furthermore, the probability of disagreement between manufacturer and customer with regard to the dyeing strength of lots should be very small when uniform material similar in hue and brightness to standard is delivered.

Electrolytic Process for the Regeneration of the Waste Waters of Various Chemical Treatments

By the SOIE DE CHATILLON CO., LTD., Milan

(*Giornale di chimica industriale, No. 5, 1926*)

Translated by Dr. Paul Barthelow

[NOTE—In order to complete the description of methods proposed for the purification of the waste soda liquor in the manufacture of artificial silk, we find this an opportune moment to give a literal report of the patent taken out by the limited Italian company, La Soie de Chatillon, of Milan. The Italian patent of January 13, 1923, has the number 216,904, the French patent of April 25, 1924, has the number 575,633, and the Belgian patent of February 15, 1924, has the number 315,516.]

IT is known that alkaline solutions move toward the cathode under the action of an electric current, and that this movement, however, takes place through separating in a suitable manner the anode portion from the cathode portion by means of a porous membrane. It happens simultaneously, under the action of the electric current, that the cations of the alkali move to the negative pole, depositing and liberating themselves and reacting with the surrounding medium.

An analogous phenomenon occurs with acid solutions when we employ an electropositive membrane,

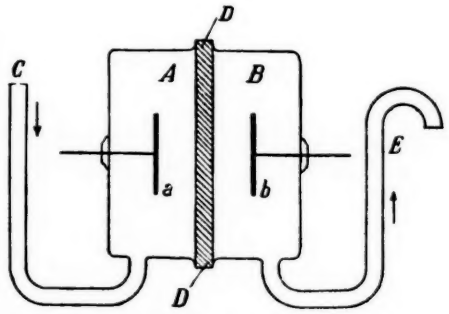

FIG. 1

Apparatus for the Regeneration of the Residual Soda Liquor from the Manufacture of Alkali-Cellulose.

while with an electronegative membrane the liquid will move in an opposite direction or be dispersed toward the anode region, including always the ions in the usual manner. These phenomena may be employed with advantage for the regeneration of solutions, acid or alkaline, which contain colloid substances capable of being held by the membrane. At the same time, it is possible to have an oxidation and reduction of the substances suspended or in solution, since a portion of the oxygen and hydrogen is liberated at the electrodes, and these secondary reactions can be successfully adapted to the regeneration of solutions coming from well-known treatments of organic substances; for example, alkaline solutions coming from the various treatments of cellulose (white waters and liquors from the paper machine and pulp mills, from soda factories and from the conversion of cellulose into alkali-cellulose, etc.), or else from treatments of various organic substances (fusion with alkalies, purification of raw petroleums and their fractions, sulphonations, etc.).

THE APPARATUS

The practical method of conducting the process is very simple, and it may be operated in tanks separated by a porous diaphragm or frame, in one part of which are poured the solutions to be regenerated; in the other part is placed water; or the liquor to be regenerated may be contained in a middle chamber between two diaphragms and, as a general rule, in the manner which seems most convenient. An example, among others, is given in the accompanying illustration of the design of the apparatus. Suppose that the liquor to be regenerated is the soda waste lye or residual liquor from the manufacture of alkali-cellulose:

The waste or residual liquor is introduced into the coil c (under low pressure) in the anode chamber A, in which the anode a is placed, and which is composed of suitable material (nickel or iron in case of alkaline solutions). This chamber is separated from B by means of the porous diaphragm D (cement, porcelain, asbestos, in this case), where the cathode b is placed. The liquid flows through the syphon E, which is capable of being regulated at the level of the stock outlet. The disposition of the various parts may be conveniently changed according to circumstances.

SUMMARY

1. Process of recovery based on the phenomena of liquid cataphoresis and electrolysis associated together (electro-osmosis) for the purpose of conveying to the anode or cathode zone, respectively, acid or alkaline

solutions and for the recovery of impure liquids with an equal reaction; of substances in suspension or organic substances, as the case may be.

2. Application of the process as described in (1) to the purification of waste liquors in the manufacture of organic products; or purification of liquors from the digesters in the manufacture of pulp, paper, alkali-cellulose, viscose, etc.

3. Application of the process described in (1) to the purification of acid solutions arising during various chemical treatments.

4. Application of the process described in (1) to the regeneration of solutions usually coming from the various chemical treatments and containing substances in suspension or solution feebly capable of ionization.

5. The apparatus, the design of which is illustrated in the figure, is patented by the La Soie de Chatillon Company, Ltd., Milan.

[Cf. The Electrolytic Recovery of Waste Liquors from Various Chemical Processes, L. Cerini, Giornale di chim. md. 1926, No. 8, p. 238. Also Der Papier-Fabrikant, 1926, 46, p. 715.]

ANNUAL OUTING OF THE S. O. C. M. A.

An interesting program, comprising a business session and two days of varied recreation, has been arranged for the annual outing of the members and guests of the Synthetic Organic Chemical Manufacturers' Association. The outing will be held Thursday evening, Friday and Saturday, June 2 to 4, at The Wyandotte, Bellport, Long Island, sixty miles from New York on the South Shore.

The business meeting and conference of the board of governors will take place Thursday evening. A golf tournament will be held Friday morning, and full facilities for tennis, boating and fishing will be provided to complete the recreational program.

Trains for Bellport leave the Pennsylvania Station, New York, via the Long Island Railroad, at 4.31 p. m. (daylight saving time) Thursday, June 2, and arrive at Bellport at 6.15 p. m. Buses will carry members to the hotel, though many of those attending will probably come by automobile.

AMERICAN CELLULOSE BECOMES CELANESE CORPORATION

Celanese Corporation of America is the new name of the American Cellulose & Chemical Manufacturing Company, Ltd., manufacturer of Celanese brand yarns and fabrics.

The change becomes effective immediately, it has been announced by Major E. E. Boreham, vice-president of the company. Trade practice for some time has been to refer to the American Cellulose & Chemical Manufacturing Company, Ltd., as the "Celanese company," and the official change in name is recognition of the wide acceptance the name Celanese has received.

SILK MAKERS' STANDARDS ACCEPTED BY GOVERNMENT

Silk manufacturers when submitting bids for Government supplies have found that the specifications were not always clear and satisfactory in meeting factory requirements. Subsequently a committee was formed to analyze these specifications for silk articles, with a view to compiling simple but complete requirements that would meet the needs of the Government and be practical for the manufacturer.

A standard outline form for Government specifications, drawn up by a committee of the Silk Association of America, Inc., has been accepted by the Government Specification Board. A letter from Edward T. Pickard, chief of the Textile Committee of the board, advises the association that the outline, with comments by the Army Air Corps, was concurred in.

The difficulties of the problem engaged manufacturers in detailed study for many months, and in their work they were assisted by Government departments. Samples of a number of silk articles used by the Government, such as middy ties, cravats, lining satin and lacing cords, were supplied each member in order that they might make a comparative study of the technical requirements of the specifications and how they were applied to the fabrics. The association's committee, of which Albert Tilt was chairman, completed its work last fall.

TAG OPENS CLEVELAND BRANCH

The C. J. Tagliabue Manufacturing Company, of Brooklyn, N. Y., maker of industrial instruments, has opened a branch factory at 5902 Carnegie Avenue, Cleveland.

The prime function of the new factory will be repair work, with special attention to emergency orders. The repair facilities of the main factory in Brooklyn have been nearly duplicated, in special equipment, in trained personnel, and in other respects, except only that of size. In addition to repair facilities there will be maintained stocks of all standardized instruments.

The new Cleveland factory is in charge of the district manager, A. R. Anderson. F. A. Denz, F. L. Frock and F. Cramer have also been assigned to special work at Cleveland.

NEW CUTCH BROWN ON NATIONAL LIST

A new Sulphur Brown of cutch shade has been introduced by the National Aniline & Chemical Company under the brand name of National Sulphur Brown RD. It is described as having excellent solubility and good leveling and penetrating properties, and is recommended for use in combination to produce tans, khakis and browns in all types of pressure and continuous machines and jigs. This color is said further to possess all-round good fastness and is somewhat improved by aftertreatment with chrome and copper.

Proceedings of the American Association of Textile Chemists and Colorists

The American Association of Textile Chemists and Colorists

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APRIL MEETING OF THE NEW YORK SECTION

The regular April meeting of the New York Section of the American Association of Textile Chemists and Colorists convened Friday, April 22, after a dinner at the Machinery Club, New York City, Herbert Grandage, Chairman of the Section, presiding. About forty-five were present. When the routine business of the section had been transacted, the Chairman introduced the first speaker.

Chairman Grandage—Our first speaker to-night, gentlemen, is Mr. E. V. D. Wallace, of Skinner Brothers Manufacturing Company, Elizabeth, N. J. Mr. Wallace will address us on "The Elimination of Vapor in the Dyehouse." Mr. Wallace! (Applause.)

Mr. Wallace—Some people say there is something in a name. My initials are E. V. D. and not B. V. D.

The other evening as I was trying to think out what I should talk about to-night, getting my facts together, and so forth, the thought crossed my mind that I really had never read any paper on the elimination of condensation and vapor in dyehouses, and I have never read a book on the subject. I do not know how I happened to get into this class of work. It was forced upon me, I guess, by my company and I had to take what came.

I haven't had much opportunity to talk to any of the engineers along this line, and I really don't know how much has been done by other concerns or engineers on the removal of vapor condensation and drippage in dyehouses. What I tell you to-night will be entirely what I have observed, what I have worked on, and conclusions I have drawn therefrom, and goodness knows I have been in a lot of dyehouses, good, bad and indifferent.

. . .Mr. Wallace then presented his prepared paper:

The Elimination or Control of Drippage and Steam Vapor in Dyehouses

By E. V. D. WALLACE
Skinner Brothers Manufacturing Company

Dyehouses do not stand alone as sufferers from the vexatious problem of steam vapor and drippage. For many years paper manufacturers have fought this trouble in their paper machine rooms, and a solution has been worked out which will produce very satisfactory results, so that to-day a paper mill is seldom built without due consideration as to means and methods of taking care of the vapor rising off the machines. This same problem is found in dairies, laundries, slaughter houses and factories where cooked foods are prepared for canning.

Only recently our company was asked to work out a method of preventing sweat between steel sheets in the warehouse of a steel mill. This sweat caused rust and made the sheets unsuited for use. It was necessary for the manufacturer to find a remedy for this.

It is really surprising to see how many different places this question of excess humidity is found. Only last week I had occasion to call on a large poultry raiser who used some of our equipment, and he told me he had found

by controlling moisture in his chicken houses he had materially increased his egg production.

That is an absolute fact. I saw his statistics and his records on that phase of the work, and it is the only case that I have ever heard of in this country where heat had been applied to a poultry house to increase the egg production.

I presume that years ago, when dyehouses were fewer and farther apart, the foggy conditions and drippage in them were considered a necessary evil; but since it has been shown that any climatic condition can be created artificially, the dyehouse managers have looked for improvement along this line in their places of business. In fact, owing to the increasing cost of labor and repairs, the exacting reguirements upon the dyers and colorists, and the demand for quality and quantity production, they have really been forced to focus their attention upon some means of remedying this evil.

Causes and Conditions of Vapor Trouble

The trouble usually occurs in dyehouses during the winter months, the same as in paper mills, etc. When the cold air from outside drifts into the room through open doors, cracks and openings, and comes into contact with the moist air of the room, the atmosphere seems to flash into fog, making conditions in the place almost impossible.

A year ago last January I had occasion to go to Connecticut to one of the largest dyehouses in the country. If I should mention the name of the dyehouse you would all recognize it immediately. It had never had a moisture absorption system. The plant had been in operation for a great many years, and the dyehouse is about 100 feet wide, and a little over 200 feet long, and located in the basement of a five-story building.

When I went into that dyehouse that morning at about eight o'clock it was absolutely impossible for me to see my hands in front of my face any place in it. I went there to measure it and make recommendations as to how to clear the place of fog and drippage.

In order to get my measurements and to get the location of the place, I had to crawl along on my hands and knees from one side of the room to the other, following the crack in the concrete floor. I believe it was one of the most foggy places I was ever in, and how human beings could work in there was more than I could see.

Dyehouses are very seldom troubled with this foggy atmosphere in summer, although I have seen some which were not located in good places filled pretty well with condensation and vapor. Usually the warm air itself in summer will clear the house if windows are left open.

There are two causes for excess humidity in dyehouses. The free surface of water exposed to evaporation, whether it be in vats, tubs, or on the floor, and the escaping steam, whether it be from hot water, boiling off, or from uncontrolled traps, bleeders, or free exhaust from steam engines.

What I mean by uncontrolled traps, bleeders, and free exhausts from steam engines is this: I have seen a great many dyehouses where very little attention has been paid to taking care of the condensation from steam engines. I have seen many places where the traps are allowed to draw on the floor and throw their steam vapor into the atmosphere. In places of that character, if these had been controlled, if the condensation had been taken back to the sump, or had been drained into covered returns, 50 per cent of the vapor in the plant could be prevented.

If steam is not used, but a large free area of cold water is exposed for evaporation, sooner or later the air in a dyehouse becomes saturated with moisture and the presence of this moisture is noticed in the form of globules of water hanging from the overhead members, such as roof, ceiling, beams and cold water pipes. Such a cause is comparatively easy to remedy, but it is the rising steam from hot water vats and other machines which has caused owners no end of trouble and worry.

Effects of Excess Humidity

We all know only too well what the effects are from excess humidity and foggy conditions in a dyeing establishment. However, for fear that some of you are not fully acquainted with the tremendous damage that often occurs, I list a few of them:

1. Rotting out of roofs or ceilings. I have seen wooden roofs rot out in a paper mill in less than three years, and in about that same length of time in some of the dyehouses.
2. Rapid deterioration of machinery due to rust.
3. Drops of water containing impurities, spotting the goods.
4. Slippery floors.
5. Unhealthful atmosphere for employees.
6. Hazardous occupation.
7. Electric short circuits causing fires and production delays.
8. High insurance rates, both fire and compensation.
9. Loss in production.
10. Shorter depreciation period on building and equipment. (This depends on amount of acid in atmosphere.)

Of course, this depreciation period depends a great deal on the acid in the atmosphere. Some houses will go along with their equipment for a good many years with practically no depreciation at all other than what you would find in the ordinary manufacturing establishment. On the other hand, I have seen fans in some of these houses rust out (if they were not coated with the proper kind of paint or covering) in three months. A case came to my attention to-day where some of the equipment that

was put in about three months ago is starting to go, and when it starts it goes very rapidly.

Remedies

If all dyehouses could be built on one pattern, or on certain rules to be laid down for their construction and operation, a solution of this problem could be standardized and thereby simplified. I have reference to the paper mill industry; that industry is pretty well standardized, so far as the machine rooms are concerned; they all aim to have high ceiling and light rooms and to put their machines above ground and in places where the rooms can be easily treated with forced hot air; that is not so in the dyeing industry and perhaps you fellows know that as well as I do. In going over some of these Manhattan Island plants I have seen dyehouses down in the basements of loft buildings or on the top floors of loft buildings—the most miserable place in the world to get at to put in any equipment at all. Oftentimes I have wondered how they get along as well as they do. But as we have to take them as they come, I must say that no one business that I have come in contact with has such a variation of location, condition, and management, as does the dyeing business. In other words, we cannot pick our time or place of dyeing.

The principle involved in a so-called moisture-absorption system is a simple one and based on a fundamental law of physics. It consists of bringing into the room sufficient quantities of fresh warm air, sweeping the entire area above head height, and exhausting it at some definite point. As this blast of warm air travels from the entrance to the exit, it absorbs the moisture that comes in contact with it on this travel, because warm air has a very great affinity for moisture. Hence this blast of air may be likened to a huge sponge, and is used as such. As there is no means of accurately determining how much moisture is given off in any one dye room over a given period, one must be guided by experience as to the amount of air to be tempered and introduced.

It is generally conceded that the best way to introduce this tempered air is by means of the unit heater or heaters, with fan intakes connected to the outside atmosphere through fresh air ducts in which are inserted recirculating dampers. The steam coils of these unit heaters are connected to any source of sufficient steam supply.

For fear that some of you don't know what a unit heater is, I will explain that it is merely a series of steel coils or copper tubes closely nested together and housed in a steel casing, underneath or above which is placed a fan for circulating the air over the coils and blowing the air out as tempered warm air. These heaters are built in various sizes, small, large and medium, and can easily be placed on the floor, the ceiling, or the wall. The fan intakes, as I have said, can be hooked up to the outside atmosphere through fresh air intakes and recirculating dampers, and they can be placed in different positions so that it is an easy matter, as a rule, to get fresh air into the room, provided the dyehouse is not built down underground, and provided the floor is not so well taken up with vats, and so forth. By the way, the unit heater business has become quite a business, and it is becoming the standard method of heating industrial buildings. The unit heater has found a great many places for its use, not only in the heating line and in dyehouse work, but also in various forms of drying and cooling.

The fact that these heaters are built in different sizes, and can be placed advantageously around the room, making it possible to inject air into the room at different points, makes them an ideal machine for this class of work. For one to get an idea of the amount of air necessary, experience has shown that a complete change of air is needed every three minutes in the low ceiling type of house, and not more than five minutes in a high ceiling type.

We can differentiate between the two kinds of houses. The low ceiling type being one of about 14 feet in height, and the high ceiling type 20 feet or higher. Naturally, it is not necessary to change the air so often in the high ceiling type as it is in the low ceiling type, as most of the absorption occurs above head level.

I will not discuss here the technical calculations necessary to be considered in the various kinds of houses to arrive at the amount of equipment required to properly eliminate the vapor, but suffice it to say that it varies with the size of room and individual conditions, and what results are required, but it is costly to say the least. However, if it is properly installed and properly operated, it will pay for itself very quickly, and you can rest assured that an investment in equipment of this nature is a very good one.

Some owners have said: "Why go to all that expense when Mr. So-and-So has a few ventilators on his roof, or a few fans in his windows, and his conditions are perfectly satisfactory?" I have sometimes been inclined to tell such a man that I believe he has a few shingles off his roof, because while such may be the case, the odds are entirely against him, for their are no two dyehouses alike or operated alike, and each job must be solved as a problem of its own.

We do run into freak conditions. There is no question about that. I know of a house in Paterson in which there is one fan in the side wall, and the dyehouse is properly ventilated, there being practically no vapor or drippage in it at all, but it happens that that room is directly connected with several other rooms and that fan naturally draws its warm air from these rooms, the air passing over the tubs on its way to the exhaust fan. They have an

ideal condition. But if a man were to try to apply that same installation in his own dyehouse, he might get terribly fooled.

Ventilators or exhaust fans of proper size and proper location are a necessary adjunct to any moisture absorption system, as they exhaust the moisture laden air from the room after it has done its work.

I have seen some places where hoods were used over machines which rectified conditions; also places where duct systems were used with hot blasts of air playing on the ceiling. I have also seen places where owners have gone to enormous expense to insulate the roof with false ceilings or several inches of cork or felt, but if moisture is prevalent in a room it will condense on anything when the atmospheric conditions are right.

A well-known engineer in New York at one time raised the question with me as to the insulating of a roof on a paper machine room to stop drippage. I told him at that time (this was several years ago) that I didn't think it would make any difference to speak of to put four inches of cork on the roof. I didn't have any particular reason for saying that; I simply had a hunch. He thought that he could remedy his condition by insulating the roof of the machine room with 4 inches of cork. In connection with the job in Connecticut which I told you about a few minutes ago, that dyehouse room was in the basement of a five-story building. One can't get better insulation on a roof than another heated story directly above. I don't care how much cork you put on. That happened to be a concrete ceiling and at the time that I was there the temperature in the second story was about 70 degrees, and the moisture was dripping off the ceiling of the dyehouse like rain. I was convinced then that while the cork would undoubtedly help a great deal, yet it would not eliminate the drippage.

So I have come to the conclusion that the unit heater, properly used with its attendant means of exhaust, is by far the most satisfactory way and the most practical method of eliminating vapor and controlling drippage. With the use of this system it is necessary to hood the machines or to go to great expense to insulate the roof. A few careful considerations in the construction of the building, the placing of pipes and drains, can be worked out to the advantage of all.

In a paper mill in the South which I worked on a year or so ago, the machine room has a flat ceiling and is the first story of a 4-story building, all concrete with glass windows. We have several heaters in that room, and last winter they went through the season without a drop of moisture on the ceiling, without a cloud of vapor over the machine at any time, and the fans at the other end of the machine exhausted the moisture-laden air. The temperature in the room was never over 80 degrees. That convinced me beyond a shadow of a doubt that it is not necessary to hood the machines in dyehouses, or even in paper mills.

Control of Vapor by Steam

There are no figures available as to the amount of steam necessary for the unit heater coils. Several years ago it was thought a considerable amount was necessary but experience has shown that the steam supply should be put under thermostatic control, permitting only about 100 degrees air or less, leaving the heaters. This cuts down the use of the steam tremendously, and economizes directly upon the coal pile.

A few years ago if you talked to a man about installing an absorption system in his dyehouse, the first question he would ask was: "How much steam is it going to take to absorb this moisture?" We really did think at that time that it took considerable steam, but it has been surprising to find out during the past years how little steam really is required. It is just a matter of tempering the incoming air which is at an average of 30 to 40 degrees, to around 90 or 100 degrees, sometimes 120 degrees.

By the use of this comparatively low temperature air, the moisture is quickly absorbed, and at the same time the temperature of the room is easily controlled and seldom gets beyond an unreasonable degree.

I do not know of any State other than Pennsylvania which has taken any steps towards governing conditions in dyehouses, so far as vapor removal and drippage is concerned, and improving the working conditions. We have had up with the City Health Board here in New York something along this line, but they really have not given us any satisfactory guide as to what might be required.

The Association of Dyers got together in the State of Pennsylvania a couple of years ago and got this rule passed for the Department of Labor and Industry, and I will read to you what they require. It is Rule 275, under Heating and Ventilating:

"Dyehouses shall be equipped with ventilating systems which will produce the following conditions: During the months of November, December, January, February, March, April and May the temperature of the dyehouse shall be maintained between 40 and 45 deg. Fahr. During this period when the weather is clear and the outside temperature is 40 degrees or more, the dyehouse shall be kept free from steam to a height of 6 feet from the floor.

"The ventilating system employed to produce this freedom from steam shall be maintained in operation during less favorable weather conditions.

"During the months of June, July, August, September and October, the dyehouse shall be kept free from steam at all times to a height of 6 feet from the floor. The systems which are used to produce these conditions may consist of ventilating fans, heating coils, hoods with flues

attached over kettles, introduction of hot air, or other natural ventilating devices."

It is absolutely impossible to clear up conditions perfectly in some houses. The construction of the building or the placing of equipment prevents a perfect job. There are times when tanks are boiling off and the vapor rises up in great clouds and you can't absorb that before it gets to the ceiling, but those tanks boiling off are only intermittent in operation, and shortly after they have ceased the blast of warm air comes along and the ceiling becomes dry again. Outside atmospheric conditions always have a great bearing on inside conditions.

One of the first jobs that I did was in a dairy in Syracsue, New York. The building had been built seven years before this job went in, and the ceiling had never been dry. After the equipment was started up, the ceiling dried off in about half an hour, and I guess it has been dry ever since.

It is not necessary in a dyehouse to have an exceptionally high temperature. I have seen the temperature in dyehouses run up to over 100 degrees. If the equipment is properly operated, the temperature can be held down easily to between 80 and 90—and you notice the State Code of Pennsylvania requires not over 95 degrees. Of couurse, the humidity conditions in the dyehouse make it seem unbearably hot, but the actual temperature should not go above 80 at any time, unless the outside temperature is pretty close to that.

I might say one thing about the operation of equipment in dyehouses and the co-operation of the employees in dyehouses. I have found among most of the dyehouses that the labor connected with the steam plant is not any too good. The men there either have too much work to do, or they are not fully acquainted with the equipment, and many times equipment doesn't get a fair "chance" in some of these places.

I believe that is all I have to say. Thank you. (Applause.)

Chairman Grandage—The meeting is open for discussion and questions on Mr. Wallace's paper. Are there no questions at all? Apparently, you all have good dyehouses. (Laughter.)

Our other speaker for to-night, gentlemen, is Mr. W. S. Schillinger, who has agreed to deliver a paper on Amzo. As your notice mentions, this is a new chemical solution for washing and bleaching in one operation.

Mr. Schillinger! (Applause.)

"Amzo"—A Washing and Bleaching Agent

By William S. Schillinger

American Soap Corporation.

Mr. Chairman and Gentlemen: When we were invited to read a paper before your organization regarding Amzo, a washing and bleaching agent, we fully appreciated the honor you were bestowing upon us. So with your kind indulgence for a few minutes I will endeavor to make you acquainted with its uses and application.

It is, I might say, so new that we have just about passed the experimental stage as we have been perfecting it for the past seven months, and now have it commercially perfected for degumming and bleaching silk, washing and bleaching cottons and rayons and, in fact, all yarns and fabrics of the vegetable family. It is a liquid solution composed of several different chemicals.

Now the question arises as to what causes the bleaching action. We can assure you it will have no ill effects on your merchandise providing you use it according to our instructions. I say this advisedly because we have samples of silks, cottons and rayons that we processed seven months ago. These particular samples were removed from the bleach bath and dried just as they came from the bleaching liquor without any aftertreatment, and today are, to all appearances, just the same as when they were processed. We even went farther, put them in envelopes and sealed the envelopes tight to keep them from the air to see if they would turn yellow, but they retained their original whiteness.

There is only one thing that we would caution you against and that is, do not allow your wash or bleach bath to come in contact with brass, because brass elements will counteract your bleaching action. Metals of any other nature, however, will not interfere with the bleaching effect.

We have found that cottons, if mercerized in the greige, bleach exceptionally rapid and without affecting the luster or tensile strength. Our experience up to this time has been that we can bleach out any grease or oily substances except that containing graphite. Amzo is also a water softener. But we do not stress this feature because we were in one bleachery which had such extremely hard water, it was necessary to use such a large quantity that it made the cost prohibitive.

Finishers are using this product for silk, cotton and rayon in a practical way. Just how they are using it I am unable to say, because they have not passed along that information to us. But we assume they first tried it in their laboratory and governed themselves from these tests, and this procedure we always recommend to anyone interested. We, of course, know that it can be used on large lots of goods, but unfortunately we have no figures in our possession as yet of consequence that would guide you in that respect.

The bleaching action takes place partly through the action of the chemicals and partly through oxidation

At present Amzo is made in three numbers, namely:

Amzo No. 1 for degumming and bleaching silks, also silk and rayon mixtures.

No. 1a is a wash for vegetable matter.

No. 2 is for washing and bleaching cotton and cotton and rayon mixtures.

Amzo No. 1. By using two ounces of No. 1 to one gallon of water at a temperature of 180 to 190 deg. Fahr., you will get a complete degumming in anywhere from ten to fifteen minutes. By using four ounces of No. 1 to a gallon of water at the above temperature, you will degum and bleach in about forty-five minutes to one hour. This, of course, refers to such silks as Yellow Italian.

Amzo No. 1a is for washing vegetable matter only. Use two ounces in one gallon of water at the boiling point, 212 deg. Fahr., for about thirty minutes. If this washing process is used it will reduce your time for bleaching about 50 per cent when bleaching with No. 2. For silks and rayon mixtures use two ounces to a gallon of water at a temperature of 170 deg. Fahr.

Amzo No. 2 is for washing and bleaching cotton and cotton and rayon combinations. For a fairly clean cotton use two ounces of No. 2 to one gallon of water at a temperature of 180 deg. Fahr. But for Egyptian cottons and goods with motes use four ounces to a gallon of water at the above temperature, and a commercially perfect white will be obtained in anywhere from thirty minutes to two hours, the time depending entirely upon the grade of yarn and the density of the fabric being processed. Our experience has been, where a cotton and rayon combination is made, that they use a fairly clean grade of cotton so in such goods you will use two ounces of No. 2 to one gallon of water at a temperature of about 165 to 170 deg. Fahr. Then we know you will not injure your rayon.

In all cases you give your merchandise a plain water rinse after processing, preferably hot water, I would say at around 130 deg. Fahr. However, you can use your own judgment as to this particular temperature, because it will depend entirely upon the goods you have in work.

We are now perfecting our boil-off and bleach for silk and cotton mixtures and hope to have this ready within the next week or two; as yet we are not satisfied with its bleaching qualities.

I might say that we have that to the point where you can use it for any tint, any pastel shade, although we haven't gotten it to the point yet that we are entirely satisfied.

By using the prescribed quantities of Amzo you will readily see the marked saving in the cost of your washing and bleaching agents. And most important of all is the enormous amount of time saved in processing your goods.

You understand, of course, that it is necessary to give only one bath. You use nothing except water in Amzo, just plain water.

I thank you. (Applause.)

Chairman Grandage—There is one remark in Mr. Schillinger's paper which I don't agree with at all. He said he regrets that he doesn't know anything about our science. I think some of the rest of us regret that we know anything about it at all. (Laughter.)

Is there anything else to come up at this meeting?

. . . A nominating committee consisting of P. J. Wood, Joseph Lange and Dr. Pickrell was appointed by Chairman Grandage. . . .

. . . It was voted, upon motion regularly made and seconded, that a rising vote of thanks be extended to the speakers of the evening. . . .

. . . A motion was then made, seconded and carried that the meeting adjourn. The meeting thereupon adjourned at eight-fifty o'clock.

APRIL MEETING OF PHILADELPHIA SECTION

. The regular April meeting of the Philadelphia Section of the American Association of Textile Chemists and Colorists was held in Philadelphia on Friday evening, April 22, 1927.

At 6.30 p. m. seven members met for the usual informal dinner at the City Club of Philadelphia.

At 8.15 the meeting proper was called to order in the Student Club Room of the Philadelphia Textile School by the chairman of the Program Committee, Chas. E. Mullin, who acted as chairman in the absence of Wm. R. MacIntyre.

The minutes of the previous meeting were read and approved as read. There being no reports of committees and no new business, Mr. Mullin introduced Dr. W. A. Taylor of the LaMotte Chemical Products Company, of Baltimore, Md., as the speaker of the evening, who then read a very interesting paper on the subject of "Control of Acidity and Alkalinity by Hydrogen Measurements." Doctor Taylor freely illustrated his paper with experiments showing the use of indicators in the determination of hydrogen ion concentration. After a brief discussion of the paper the meeting adjourned with a rising vote of thanks to the speaker, to meet again in October, 1927. Dr. Taylor's paper appears below.

There were twenty-two present.

PERCIVAL THEEL, *Secretary.*

Proceedings of the American Association of Textile Chemists and Colorists

Control of Acidity and Alkalinity by Hydrogen Ion Measurements

By W. A. Taylor
President, LaMotte Chemical Products Company.

Introduction

Acidity and alkalinity have long been considered as important factors in practically all branches of both research and industrial work. Until the past few years, however, acidity and alkalinity were determined and regulated chiefly by means of litmus and other test papers and by titration. The introduction of hydrogen ion control showed that the older methods often give very erroneous and misleading results, and explained why processes, which were apparently carried out under the same conditions, do not give a uniform product.

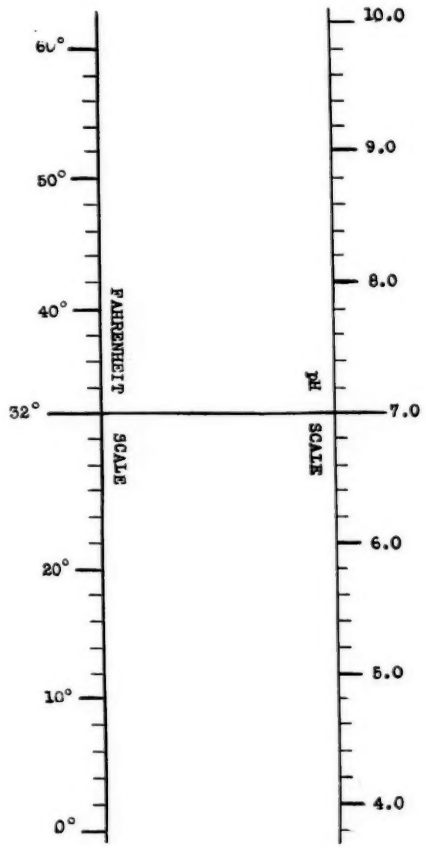
Although hydrogen ion control has proved its value and has therefore been widely adopted in many different lines of work, many still hesitate to use it, since they feel that its application requires the services of a highly trained chemist. We shall show that this is not the case. In fact, it is just as simple to make a determination of hydrogen ion concentration as it is to make a measurement of temperature, and these determinations can be made just as easily and accurately by a plant foreman as by a trained chemist. The only requirements are that the operator be able to read and to match colors.

Meaning of pH Scale

Everyone is familiar with the Fahrenheit thermometer. On this scale, 32 degrees represents the freezing point of water. For the sake of illustration, we shall assume that values above and below 32 deg. represent degrees of heat and coldness respectively. Thus, any values higher than 32 deg., such as 34 deg., 36 deg., 40 deg., etc., denote an increase in heat, the degree of heat *increasing* as the numbers *increase*. On the other hand, any values below 32 deg., such as 30 deg., 28 deg., 20 deg., etc., denote an increase in coldness, the degree of coldness *increasing* as the numbers *decrease*.

In a similar manner the degree of acidity or alkalinity of a solution is expressed by the hydrogen ion or pH scale. Instead of being called degrees, as in the case of the thermometer, the units on this scale are called pH values. It is apparent that it is not necessary for a person to know the derivation of the term "degree Fahrenheit" in order to determine the temperature of a solution. It is equally true that the worker need not know the meaning of the term "pH" in order to use this method for measuring acidity and alkalinity. On the hydrogen ion scale, a value of pH 7.0 represents neutrality. This means that if the material being tested has a pH of 7.0 it is neither acid nor alkaline.

Following the illustration of the thermometer given above, any values higher than pH 7.0, such as 7.2, 7.4, 8.0, 9.0, 10.0, etc., denote alkalinity, the degree of alkalinity *increasing* as the numbers *increase*. Analogously, any value lower than pH 7.0, such as 6.8, 6.6, 6.0, 4.0, 2.0, etc., denote acidity, the degree of acidity *increasing* as the numbers *decrease*. This will be clear from the following figure:



A pH value is therefore simply a number denoting the degree of acidity or alkalinity of a solution, and an operator will learn in a few days to use this term just as intelligently as he does the term "degree Fahrenheit." To give a concrete example, let us say that a solution has a pH value of 7.6. The solution is, of course, slightly alkaline. If another has a pH of 8.2, it is more alkaline than the one of pH 7.6. It is therefore clear that an acid or acid salt must be added to a solution of pH 8.2 to bring it to a pH of 7.6 and that larger quantities must be added to bring it to the neutral point of 7.0, or to an acidity of pH 6.6, 6.0, etc. Similarly, if a solution has a pH of

6.0, it is acid and it is necessary to add alkali to it in order to bring it to the neutral point pH 7.0, or to an alkaline value such as pH 8.0, etc.

Since we have explained the meaning of the pH scale, and the way in which a solution is changed from one pH value to another, all that is required is that the operator know what pH value should be maintained in a given operation and how to make the measurements.

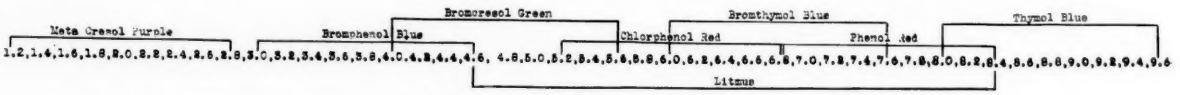


Chart Showing How Indicators Cover Entire pH Range

Making Determinations

Indicators

The principle of making pH measurements is based on the fact that various indicators change in color when they are acted upon by solutions of different acidities or alkalinities. Litmus paper is probably the simplest and most universally known example of an indicator. Its color change is from red to blue. That is, if litmus paper is dipped into an acid solution, it turns red. If it turns only slightly red, we say the solution is "slightly" acid. If it turns deep red we say the solution is "strongly" acid. Similarly if the paper turns blue, we say the solution is "slightly" or "strongly" alkaline. These are very vague and indefinite terms and their meaning varies enormously, depending largely on the personal opinion of the worker. Thus, what is "slightly" acid to one worker might be considered as "strongly" acid by another, and vice versa.

In making pH measurements, we simply substitute definite pH values, such as 3.0, 6.0, 6.8, 7.4, 9.6, etc., for the indefinite terms "strongly" and "slightly" acid and alkaline. These pH values can be recorded and can be duplicated at any time by the same or different workers.

Theoretically, litmus and other test papers can be used for determining the pH of a solution. In practical application, however, the error is too great. One of the chief reasons for the inaccuracy of litmus is that the range is so wide (pH 4.6 to 8.4) that the intermediate color changes are not distinct. It is practically impossible to tell the difference in the colors produced by solutions having pH values which differ by 1.0 pH unit. In fact, it has been shown in actual practice that solutions which specially prepared litmus indicated to be alkaline were really acid, and vice versa, when accurate pH measurements were made on the same solutions.

Some other test papers are more sensitive than litmus, but it is very doubtful whether differences of less than 0.6 pH can be detected by their use. Even this degree of accuracy is seldom obtainable, as it is exceptional to obtain two batches of test papers which will give the same readings. Granting that a uniform paper can be obtained, we have no standards by which to judge. Thus a shade which would be considered as corresponding to a pH value of 6.0 by one worker, might be considered as 6.6 by another. Since variations as large as 0.2 pH may be of serious consequence, the need for an accurate method is apparent.

As stated above, litmus is very insensitive, partly because it covers such a wide range. In order to make accurate pH determinations, it is therefore necessary to employ indicators with short ranges, so that the color changes are more distinct. This means that we need a number of indicators to cover the entire pH range 1.2 to 9.6. A complete set of indicators, which were developed for just this purpose, are given, with their respective pH ranges and color changes, in the following table. The accompanying chart will make this even clearer:

Name	pH Range	Color Change
Meta Cresol Purple	1.2-2.8	Red-Yellow
Bromphenol Blue	3.0-4.6	Yellow-Blue
Bromcresol Green	4.0-5.6	Yellow-Blue
Chlorphenol Red	5.2-6.8	Yellow-Red
Bromthymol Blue	6.0-7.6	Yellow-Blue
Phenol Red	6.8-8.4	Yellow-Red
Cresol Red	7.2-8.8	Yellow-Red
Thymol Blue	8.0-9.6	Yellow-Blue

The color changes of these indicators are similar to that of litmus. For example, litmus is deep red in an acid solution (pH 4.6) and deep blue in an alkaline solution (pH 8.4). Similarly, Chlorphenol Red has a yellow color at pH 5.2 and a deep red color at pH 6.8; Bromthymol Blue is yellow at pH 6.0 and deep blue at pH 7.6, etc.

Rough Tests

If the worker has no idea of the pH value of a given solution, it is necessary to first make a rough determination. To make the test, fill a graduated test tube to the mark (10 c.c.) with the solution to be tested, and add 0.5 c.c. of Bromthymol Blue indicator solution. This indicator is tried first, since it has a pH range of 6.0-7.6, and therefore covers the neutral point pH 7.0. Hence it is possible by means of this one indicator to determine whether the solution being tested is neutral, acid or alkaline. The color change of Bromthymol Blue is from yellow at 6.0 to a deep blue at 7.6. Therefore, if on adding this indicator solution, a color intermediate between yel-

low and deep blue is obtained, the pH of the solution lies between 6.0 and 7.6, and it is either neutral or very slightly acid or alkaline. In this case no further rough tests are necessary.

If, however, a yellow color is obtained on adding the Bromthymol Blue indicator solution, the pH of the solution is at least 6.0 and possibly lower. This is due to the fact that pH 6.0 is the acid end of the range of this indicator. Even if the solution had a pH or 5.0 or 4.0, it would still give a yellow color with Bromthymol Blue. If then a yellow color is obtained, 0.5 c.c. of the Bromcresol Green indicator solution, which, it will be seen by reference to the table and chart, covers a more acid part of the range (pH 4.0-5.6), should be added to a second test tube containing the solution of unknown pH. The color change for this indicator is from yellow at pH 4.0 to a deep blue at pH 5.6. If, therefore, a color intermediate between yellow and deep blue is obtained in this test, the pH of the solution lies between 4.0 and 5.6.

These two indicators do not cover quite all the values between 4.0 and 7.6. Thus, if Bromcresol Green (pH 4.0-5.6) gives a deep blue color and Bromthymol Blue (pH 6.0-7.6) a yellow color, it is apparent that the pH of the solution lies around pH 5.6-6.0, that is, within the range of Chlorphenol Red (pH 5.2-6.8). Of course, only one indicator should be added to each tube. That is, if Bromthymol Blue gives a yellow color, the Bromcresol Green must always be added to a fresh tube. If a yellow color is obtained with Bromcresol Green, the test should be repeated using Bromphenol Blue, which covers a still more acid part of the range, pH 3.0-4.6, etc.

If, on the other hand, on adding Bromthymol Blue indicator solution in the first test, a deep blue color was obtained, the solution is alkaline and has a pH value of at least 7.6 and possibly higher. The test should then be repeated using Thymol Blue, which covers a more alkaline part of the range, pH 8.0-9.6.

This procedure must, of course, be followed in determining the range required for any specific work, that is, a rough test must be made on solutions from all steps of the process. In this way the necessary indicators can be selected.

Accurate Measurements

Let us assume that in the first rough test, that is, the one in which Bromthymol Blue indicator solution was added to the solution in the test tube, a color intermediate between yellow and deep blue was obtained. This would show that the pH of the solution lies between 6.0 and 7.6. It is now a question of determining the exact pH value. For this purpose a set of Bromthymol Blue color standards and some form of comparator are required. A set of Bromthymol Blue color standards consists of nine standard tubes and one tube of distilled water, as shown in Fig. I:

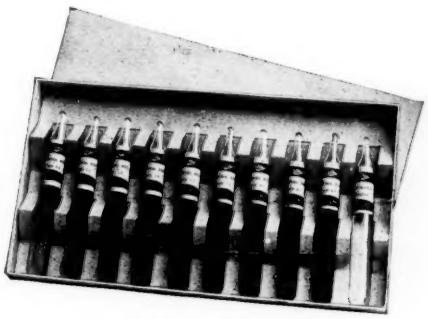


Fig. I.—*LaMotte Color Standards.*

The Color Standards for Bromthymol Blue are simply 9 tubes, containing 10 c.c. of solutions of definite pH value, that is, 6.0, 6.2, 6.4, 6.6, 6.8, 7.0, 7.2, 7.4, and 7.6, to each of which 0.5 c.c. of Bromthymol Blue indicator solution has been added. It is seen that these standards are made up in exactly the same manner in which the test was made, except that solutions of definite pH values were used. These color standards can be purchased, and it is, therefore, not necessary or advisable for the worker to make them up for himself.

The nine tubes are labeled with the pH values of the various solutions which they contain. The tube marked pH 6.0 will have a yellow color and that marked pH 7.6 a deep blue color. The intermediate tubes, which are marked 6.2, 6.4, 6.6, etc., will have colors intermediate between yellow and blue.

All that is now necessary is to match the test sample with the standards. When a match is obtained, the pH value of the solution is read off directly from the standard with which it matches.

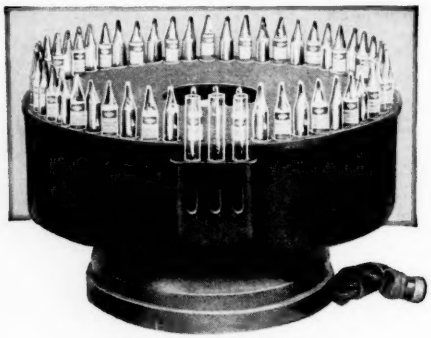
If the rough test had shown the pH of the solution to lie between 5.2 and 6.8, a tube of the unknown, to which Chlorphenol Red indicator solution has been added, must, of course, be compared with a set of Chlorphenol Red Color Standards. These are similar to the Bromthymol Blue Standards. Thus the tube marked pH 5.2 has a yellow color and that marked pH 6.8 has a deep red color. The intermediate tubes have colors intermediate between yellow and red. Analogously, if the pH of the solution were found to be between 4.0 and 5.6, the tube to which the Bromcresol Green indicator solution was added must be compared with the Bromcresol Green Color Standards, etc.

The worker should, however, be warned against possible errors due to matching against the color standard on either end of any given set. Thus, a test sample may match the Bromthymol Blue standard pH 7.6 and yet

have a much higher pH value, due to the fact that pH 7.6 is the end of the range of Bromthymol Blue. In such a case the test should be repeated using Phenol Red.

After a few actual determinations have been made the above procedure will be found to be very quick and simple. In fact, the worker will quickly learn by experience which indicator should be used in each step of a process and can therefore make the comparison directly, without first making the rough test.

We stated above that some sort of comparator is necessary in making accurate measurements. The actual procedure can be illustrated by means of the Roulette Comparator shown in Fig. II:



(Patent Applied For)

FIG. II.—*LaMotte Roulette Comparator*

CONTENTS OF SET

The comparator consists essentially of a stationary base and metal band, and a wooden drum which revolves inside the metal band on ball bearings. A block, which contains three slots, and which is drilled to hold three graduated test tubes, is fastened to the front of the metal band. A 40-watt Mazda lamp is fixed in the center of the base and is connected with a standard plug by means of a lamp cord. A piece of etched glass is fixed on the front of the test tube block and a piece of Daylite glass is placed directly behind the test tubes. With this arrangement the observer always makes his readings under standard, diffused daylight conditions, so that measurements made at night or in a dark place are just as accurate as those made during the day.

Any three sets of Color Standards, such as Chlorphenol Red, pH 5.2-6.8; Bromthymol Blue, pH 6.0-7.6, and Phenol Red, pH 6.8-8.4, and 27 ampoules of distilled water are supplied with the set. An extra polished wooden case, containing 50 c.c. bottles of the three corresponding indicator solutions, 1 empty 50 c.c. bottle, 4-0.5 c.c. pipettes with nipples, and 18 graduated test tubes, is included as part of the equipment.

OPERATION OF SET

First place the three sets of color standards and the ampoules of distilled water in the holes in the revolving drum, the color standards alternating with ampoules of water. For example, place the Chlorphenol Red color standard, pH 5.2, in one of the holes in the drum. Next to it place an ampoule of distilled water. Then insert the next standard, pH 5.4, and another distilled water, etc. After all of the Chlorphenol Red standards are inserted start with the Bromthymol Blue standard, pH 6.0, etc., and continue until all three sets are in place.

Let us assume that by a rough test we have found the pH of the solution which is being tested to be within the range of Bromthymol Blue, pH 6.0-7.6. Fill three of the test tubes to the mark (10 c.c.) with the solution to be tested, and place them in the three holes in the block. Then add 0.5 c.c. of the Bromthymol Blue indicator solution to the middle tube and shake to insure thorough mixing. Turn on the light and revolve the drum until the Bromthymol Blue color standards are directly behind the test sample. Looking toward the electric bulb through the three slots in the block, slowly shift the standards, by turning the drum, until the color through the central test tube exactly matches that of one of the tubes on either side of it, or lies between them. The pH value can then be read off directly from the color standards, as the labels on the standards project above the top of the drum. In making a reading, the drum must be turned so that an ampoule of distilled water is always in the position directly behind the central test tube to which the indicator solution has been added.

The reason for this arrangement of tubes is to eliminate any effect of color or turbidity in the sample which is being tested. For example, suppose that we are testing a colored or turbid solution. We shall designate this colored or turbid solution by "G," water by "W" and the indicator solution by "I." Referring to Fig. III, B, A and C represent the three test tubes which are filled with the solution which is being tested. D represents the ampoule of distilled water and E and F the color standards:

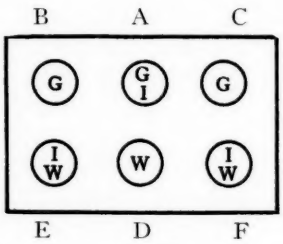


FIG. III

To make this clear, the color standards may be considered as made up of water and indicator solution. They

do, of course contain solutions of salts to give them definite pH values, but, since these solutions of salts are clear and colorless, they may be considered as made up of only these two materials.

It will be seen from Fig. III that each pair of tubes (B and E, A and D, C and F) contains the colored or turbid solution "G," indicator solution "I" and water "W," the only difference being that the indicator solution has been added to the turbid material in the central test tube, instead of to the distilled water tube which is placed in front of it. The final combination is, however, the same in all pairs. It is therefore apparent that, when the proper color standards are in place, an exact match must be obtained, since the observer is looking through exactly the same materials in each pair of tubes.

If by the rough test it is found that the pH value of the material lies in the range of Chlorphenol Red, the same procedure is followed, except, of course, that Chlorphenol Red indicator solution, instead of Bromthymol Blue, is added to the middle tube and the drum revolved until the Chlorphenol Red color standards are in position for comparison.

It will be seen that most of the indicators overlap so that it is usually possible to make determinations on the same sample with two different indicators and thus check results.

Application

There are two methods for determining the pH value of solutions, the electrometric and the colorimetric. We have confined our discussion to the colorimetric method since, as Scott[1] states, "this is the one which we find is much more adaptable for actual plant work, because it is something that is not dependent upon a delicate instrument. You can take your various indicator solutions to any part of the plant with a portable apparatus and make the determinations quickly."

Some dye solutions are so highly colored that they would mask the color of the indicator. One way of eliminating this difficulty is by dilution, as some of these solutions are so highly buffered that they can be diluted without changing their pH value. Another method is by filtering them through vegetable charcoal which will remove practically all of the color. If a good grade of charcoal which has been washed with alkali and acid and finally with distilled water is used, the pH value should not usually be changed to any great degree, especially if the solution is buffered.

Actual experience of a number of manufacturers has shown that not only can the yields of dyes and pigments be increased by regulating the pH of the intermediates, but, what is of even greater importance, that the shade can be checked in different batches. This means a great deal not only to the dye manufacturer but also the the dyer. If the dyer receives a uniform product, instead of varying mixtures which are necessary to give the correct shade, he should have much less difficulty in reproducing shades.

Scott states that in the degumming of silk he used 100 pounds of neutral soap in 600 gallons of water, and that the resulting solution had a pH of about 8.8. If 200 pounds of gum silk were boiled in this solution, the pH fell to about 8.6. Another batch of silk can be degummed in this solution, but when the pH falls to about 8.4 the silk is not completely degummed. If, however, the pH is again raised to 8.8 by the addition of sodium hydroxide, degumming is complete.

The scouring of wool is analogous and quite a little work is now being done on the application of pH control to this process. Chapin[2] studied the effects of varying concentrations of sodium hydroxide and borax on wool. He showed that "under the conditions studied pH is a better guide for predicting the probable effect of alkali on wool than is the concentration of the alkali itself. It is likely that this is true under all conditions, although this needs confirmation by experiment at higher temperatures and with chemicals more commonly used in scouring and dyeing." His conclusions were that the color increased and the strength of the wool fiber decreased as the pH was raised.

There are three common theories for the combination of dyes with fibers. These are known as the chemical, adsorption and electrical theories. It is interesting to note that hydrogen ion control is an important factor in all three theories.

Speakman[3] sponsors the chemical theory, which states that a chemical reaction takes place when wool is dyed. He points out that wool can act both as an acid and a base. In acid solution it acts as a base and in alkaline solution it acts as an acid. The amounts of acid or alkali which will combine with the wool are determined by the pH of the solution. As the pH of the solution decreases, that is, as the acidity increases, the amount of acid which combines with the wool increases. As the pH of the solution increases, that is, as the alkalinity increases, the amount of alkali which combines with the wool increases. In other words, the amounts of acid or alkalies which combine with the wool are determined by the pH of the solution and not by the total acidity as determined by titration.

Speakman carried out experiments on wool by soaking samples in potassium ferrocyanide solutions of varying pH for 24 hours, washing them and then immersing them in ferric chloride solution to form Prussian Blue. His

[1] American Dyestuff Reporter, **14,** 145, 1925.

[2] American Dyestuff Reporter, **14,** 859, 1925.

[3] Society of Dyers and Colorists, **41,** 172, 1925.

experiments were run at approximately pH 5.6, 5.3, 5.0, 4.8, 4.3 and 3.8. No combination took place above pH 4.8. Combination, however, began at 4.8 and increased as the pH decreased. Four different kinds of wool were used and all gave the same results.

Briggs and Bull[4] state that "the taking up of dyes is a case of adsorption, and that the amount of dye adsorbed varies continuously with a change in the hydrogen ion concentration of the dye bath." Speakman says that according to the chemical theory, the amount of dye absorbed from a solution of given dye concentration should be dependent only on the pH value of the solution and not on the particular inorganic acid employed, and that Briggs and Bull have shown this to be true for Croceine Orange with nitric and hydrochloric acids, since the amount of dye absorbed was found to increase regularly with the hydrogen ion concentration.

Scott[5] carried out dyeings with Patent Blue and Acid Fuchsine 6B, adjusting the pH with sulphuric, acetic and hydrochloric acids. He found (1) that "the amount of acid dyestuff absorbed by silk from a solution of given initial concentration increases with the hydrogen ion concentration"; (2) "In dye baths acidified with acetic, sulphuric or hydrochloric acids, the amount of acid dyestuff absorbed by the silk at a given initial hydrogen ion concentration of the solution is constant and is not dependent on the absolute amount of acid used to obtain this hydrogen ion concentration." He concludes "there is no question but that the hydrogen ion concentration of the dye bath is a very important factor in the dyeing of silk, and must be given careful consideration in any attempt to establish standardized dyeings."

Scott, in addition to judging the dyeings, measured the amount of dye remaining in the bath by means of a colorimeter. He states that "the colorimeter readings on Patent Blue were not very reliable because of changes in hue as well as strength, the solution becoming gradually greener as the hydrogen ion concentration increased." The measurements were, however, sufficiently accurate to show the general effect. This illustrates the influence of pH on the shade and the necessity for pH control in checking shades.

Scott also points out that much more complete and quick exhaustion of the dye bath is obtained when silk is dyed in a N/100 solution of sulphuric acid (pH 1.8) than when N/100 acetic acid is used (pH 3.4). This is due to the low pH value which is given by sulphuric acid. He has shown also that a low pH does not weaken the silk as a high pH does.

He concludes that it is necessary to maintain a constant pH in the dye bath to obtain uniform dyeings. It is not sufficient to maintain a constant percentage of dyestuff, volume, temperature, etc. The same applies to dyeing of vat and sulphur colors on silk. In vat colors their affinity for silk increases notably with reduction in pH.

White, Marker and Gordon[6] studied the absorption of Orange II and Metanil Yellow by ferric oxide and alumina gels. Ferric oxide gel absorbed 429 mg. of Orange II per gram of gel at pH 2.3, 75 mg. at 3.2 and 7.0 mg. at 5.27. Alumina gel absorbed 452 mg. at 2.3, 186 at 3.2 and 179 at 5.27. The results with alumina gel were similar.

Scott states that these results agree with his own practical observations in the dyeing of silk and that they also apply in the dyeing of wool.

The effect of pH on the adsorption of dyes by clays is clearly shown by the work of Thies[7]. He found that two different clays of the same chemical type did not behave similarly when compounded in rubber. One type gave good cures and high tensile strength, while the other type gave slow cures and low tensile strength. He also found that these two clays had very different reactions, a suspension of the clay which gave good cures having a pH value of 7.1, and that of the clay which gave poor cures having a pH value of 4.0. In an attempt to differentiate between good and poor clay for rubber work, he made measurements of the adsorption of dyes by the two types of clay mentioned above. In this work he used sixteen different dyes. The adsorption of dyes by the clay which had a pH value of 7.1 was very erratic and also very low. The average retention for the sixteen dyes was 39 per cent of the dye added. In only four cases was the retention over 50 per cent. On the other hand, the average retention by the clay which had a pH value of 4.0 was 73 per cent. In ten of the sixteen dyes the retention was over 90 per cent, and in seven it was 99 per cent or over.

In addition to dyes, Thies also ran experiments with various rubber accelerators and found that adsorption of these materials was similar to that of the dyes. In other words, the phenomenon is apparently general.

In conclusion, we do not wish to give the impression that hydrogen ion or pH control is a panacea for all the troubles of the dyer. It has, however, been found to be one of his most useful tools.

[4] J. of Physical Chemistry, **26,** 845, 1922.
[5] American Dyestuff Reporter, **14,** 145, 1925, and **14,** 862, 1925
[6] J. Ind. & Eng. Chem., **15,** 1186, 1923.
[7] J. Ind. & Eng. Chem., **17,** 1165, 1925.

ANNUAL SUMMER OUTING OF NORTHERN NEW ENGLAND SECTION

The annual summer outing of the Northern New England Section of the American Association of Textile Chemists and Colorists will be held at the North

Shore Golf and Tennis Club, Salem, Mass., on Friday, June 10.

The program has been so arranged by the committee that an enjoyable day is assured for every member and guest who attends, no matter how one's taste in sports and other recreations may run.

Every member is invited to attend and to bring as many guests as he desires, together with his own and guests' sporting equipment. The section has planned to make it one of the livest get-together events it has ever held.

Complete details regarding events and costs will be given in a later notice. Meanwhile members are urged to keep the date open at all costs.

MEETING OF THE SOUTH-CENTRAL SECTION

The organization meeting of the South-Central Section was held at the Patten Hotel, Chattanooga, Tenn., on April 30, 1927, with thirty-six members present. P. F. O'Neill, acting chairman, called the meeting to order.

The following officers were elected: P. F. O'Neill, chairman; J. D. Murray, vice-chairman; J. B. Smith, secretary; H. A. Rodgers, treasurer.

A telegram from the Piedmont Section inviting the South-Central Section to hold a joint meeting with them in July at Asheville, N. C., was read and accepted. This for the purpose of giving the South-Central Section the opportunity of hearing Prof. L. A. Olney, who is expected to speak at this meeting.

Chattanooga was selected as the permanent meeting place of this section, which was duly named the South-Central Section.

After the necessary business was finished a general discussion followed, in which great interest was shown by all present.

It was planned to make this section beneficial to its members at all times. One of the most popular suggestions was that of appointing a consulting committee representing all branches of the textile industry in this section. It would be the duty of this committee to answer all questions or offer suggestions for helping eliminate any trouble the members might have. This committee is to be reached through the chairman.

A rising vote of thanks was given the chairman, P. F. O'Neill, after which the meeting adjourned.

Many of the members after the meeting expressed themselves as finding this the most interesting one yet attended.

J. Baynard Smith, *Secretary.*

FORTY-FOURTH COUNCIL MEETING

The forty-fourth council meeting of the American Association of Textile Chemists and Colorists was held at the Engineers' Club, Boston, Mass., on Friday, March 14, 1927.

The following members were in attendance: E. H. Killheffer, W. S. Williams, H. Christison, W. C. Durfee, George A. Moran, P. F. Ripley, R. E. Rose, W. E. Hadley, R. F. Culver, W. M. Scott, William R. Moorhouse, William H. Cady, P. J. Wood, A. D. Nute, William K. Robbins and W. A. Appel. Professor Olney was prevented from attending owing to illness.

The names of those admitted to membership at this meeting will appear in another issue of the Proceedings.

The following Junior Members were changed to Active Membership:

Adam A. Hellmuth, 1239 Boulevard East, West New York, N. J.

Carl Toepler, Bellman Brook Bleachery, Fairview, N. J.

The American Rapidase Company, 171 Madison Avenue, New York, N. Y., manufacturers of enzyme products for the textile trade, were elected to Corporate Membership. Leo Wallerstein was designated to act as their representative, in the affairs of the Association.

Research Fund and Work

Some discussion took place relative to giving some special designation to the names of those who contributed to the Research Fund, such designation to appear against the names of members as published in the Year Book.

The proper method to be used in attempting to secure Corporate Members was discussed with a great deal of detail, and it was decided to get out some form of pamphlet, together with a letter describing the activities of the Association, the work which has been accomplished and the work which it is hoped to accomplish, as soon as the proper funds are available; such letter and pamphlet to be submitted to the Council for approval at an early date.

The Council voted the sum of $500 to be used in forwarding the work of the Committee on Fastness to Light, this amount being required to handle the routine work in connection with the control of exposed samples, mounting, etc.

It was voted that an appropriation of not more than $750 be made to cover the work of the Committee on Fastness to Washing of Wool; this appropriation was to cover the employment of three men at $250 each, who were to be under the direction of the Chairman of the Sub-Committee on Wool Fastness, for special work during the coming summer.

W. E. Hadley, *Secretary.*

Applicants for Membership

Active Membership

Benson, Cyrus M., proprietor, E. & R. Cleaning & Dyeing Company, Cambridge, Mass. Sponsors: N. B. Browne and B. Proctor.

Crist, John L., manufacturer dyestuffs, Damascus, Va. Sponsors: E. H. Killheffer and C. H. Stone.

Emerson, Robert M., silk dyer, Cooper Kenworthy, Inc., Warren, R. I. Sponsors: P. Theel and J. J. Sokolinski.

Herstein, Karl M., consulting chemist, 227 Front Street, New York, N. Y. Sponsors: G. W. Knight and D. P. Knowland.

Herzog, George Ernest, assistant dyer, Wood Worsted Mills, Lawrence, Mass. Sponsors: F. E. Johnson and T. J. Biery.

Levering, J. A., wool scourer, Eavenson & Levering Company, Camden, N. J. Sponsors: E. C. Bertolet and P. Theel.

Martin, Rodney, dyer, Beckwith & Co., Poughkeepsie, N. Y. Sponsors: B. Stokham and P. Braude.

Rickman, J. P., assistant resident manager, Central Franklin Process Company, Chattanooga, Tenn. Sponsors: B. R. Dabbs and T. R. Smith.

Wheatley, Arthur, foreman dyer, Finco Dye & Print Works, Brooklyn, N. Y. Sponsors: Dr. J. Colman and J. J. Sokolinski.

Junior Membership

Dick, Carroll, student, Philadelphia Textile School, Philadelphia, Pa. Sponsors: P. Theel and E. C. Bertolet.

Haack, Edward, student, Philadelphia Textile School, Philadelphia, Pa. Sponsors: P. Theel and E. C. Bertolet.

Changes of Address

Garnett, Gilbert, Wilbur Avenue, Swansea, Mass.

Hampshire, Alfred E., 63 Chandler Avenue, Pawtucket, R. I.

Hewitt, Frank C., 595 Westford Street, Lowell, Mass.

Kidd, Thomas S., Box 147, Waterford, Conn.

Leupold, H. F., 162 Wadsworth Street, South Manchester, Conn.

Schroeder, E. M. G., Robert Fulton Hotel, Atlanta, Ga.

Shane, Jr., Nat. C., c/o Celanese Corporation of America, Amcelle, near Cumberland, Md.

Ulmes, August, 9424 Eighty-fourth Street, Woodhaven, L. I., N. Y.

ASSOCIATION BADGES

The lapel button badge illustrated herewith is worn by members of the American Association of Textile Chemists and Colorists.

The three "rings" are enameled in red, yellow and blue, respectively, and the initials and border are brought out in gold. The general effect is exceedingly attractive.

Badges may be secured at $1.50 each by addressing the Secretary.

WALTER E. HADLEY,
5 Mountain Avenue,
Maplewood, N. J.

AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
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FOREIGN SENTIMENT AGAINST OUR DYE TARIFF

THE economic conference at Geneva quietly adjourned last week after a well-rounded discussion of Europe's economic ills. It was thoroughly international in scope, with delegates from forty-nine countries. Members of the American party by deliberate intent took no active part, merely contributing to the discussion whatever information and advice their experience was able to supply. Outwardly the issues discussed during the parley did not directly concern the United States.

We expected a concerted attack by the European delegates against this country's tariff policy; but perhaps out of respect for the distinguished American delegates present, this delicate subject was alluded to only in the most general terms. The party from Germany even refrained from presenting the elaborate monograph on the world's dye and chemical trade, which we understand it had carefully prepared as a kind of barrage to its drive against the dyestuff schedules of our tariff. Anyway, no word of an expressed sentiment against the American tariff policy appeared in the cabled reports of the conference.

American industry in general, however, and the dyestuff industry in particular, should not be disarmed by this apparent disregard, at a European economic parley, of what is known to be the sharpest thorn in the side of European business. We should not cease to be vigilant of any move that has the earmarks of foreign propaganda aimed at this country's tariff policy. We know that a distinct sentiment inimical to that policy exists in Europe to-day, awaiting only a more favorable opportunity to show its teeth. It really underlay much of what was said and thought at Geneva during the last three weeks. For in closing the conference its president, M. Theunis, declared that chief among its achievements had been the conclusion that the time had come to check the increase in customs tariffs, and to make an effort, first for individual action by various states with regard to their own tariffs, and second for collective action through the League of Nations to encourage extension of international trade by lowering barriers to exchange. Is it wise for us to interpret this as referring only to European tariffs?

Our readers should know that the most significant evidence of European sentiment against the American tariff was that memorandum on the world's dye trade which the German delegation to Geneva had prepared but apparently failed to use. Let us briefly examine its main points, as embodied in a version which somehow reached this country.

This German memorandum was really a very exhaustive analysis of the chemical trade of the world. It emphasized the leading place taken by the dyestuff industries of each country and reviewed national tariff policies as related to those industries. Many of its arguments were based on one premise, namely, that the total volume of world trade in dyes and chemicals has *not materially changed* in the past ten years; but that whereas most of it was under German control prior to 1917, it has now been divided among a number of dye-producing countries, this resulting in unprofitable business for all. Germany's share of this world trade, 88 per cent before the war, has dropped to 46 per cent. From this fact the German memorandum argued that since Germany's chemical industry is essential to her complete economic recovery, it should be permitted to recover most of its former monopolistic power! Amusing though this may be to us, the Germans were evidently serious about it.

This document maintained further that there are many advantages in concentrating all chemical production within the one or two countries in which conditions of manufacture are most favorable. Economically sound as this theory may be, it conveniently, almost selfishly, shuts an eye to the rather important relation of dye manufacturing to national defense. Germany's idea is, in short, that even large countries should depend on Germany for dyes and other chemicals merely because Germany has better facilities for making them.

The British were evidently aware of this monograph which the German delegation had prepared for the Geneva conference, for the British Association of Chemical Manufacturers were permitted to comment on it before the conference opened. The British manufacturers were so audacious as to take issue with Germany on some of the latter's deductions as expressed in the memorandum. They declared:

> It is admitted that to concentrate the industry in one country has certain advantages to the country itself. But the dyestuffs industry is in a very special position for two reasons: (1) on it is dependent the, commercially, infinitely greater textile industry; and (2) it provides a magnificent training ground for young chemists. It was therefore essential for Britain, in common with other countries, to provide

herself with an industry which was of such importance to national welfare.

But we are perplexed because the British also neglected to refer to the industry as an indispensable weapon of defense—to our mind one of the irrefutable arguments for maintaining a strong national dye industry protected by a tariff as high as each country deems politically judicious.

Surely there must be a sounder reason other than the purely economic one for the tariff bulwarks which all the large nations have built around their dye industries. Does anyone believe that these countries adjust their dye schedules on any basis of comparative production costs, as is done in the case of duties on most other products? There is no question but that such tariffs have been erected solely because the nature of the dye industry as the left wing of textile manufacturing and the right wing of defense justifies them. Furthermore, these same considerations will always justify even the most extreme protection of a nation's dye trade.

Because we stress this one aspect of the case for protection of the industry, it should not be inferred that we are trying to show Germany intentionally avoided this view in its Geneva memorandum. Germany is talking primarily in economic terms when she urges the rest of the world to lower its tariffs and let in her dyes and chemicals. Her tremendous plant facilities, her enlarged productive capacities, are forcing Germany to seek additional outlets at any cost and she reveals her dilemma in this specious plea for a larger share of the world trade, which from her standpoint can be secured only by attacking the tariffs of the United States and other countries.

That her elaborate survey of the chemical trade was not delivered at Geneva does not mean, of course, that no further attempt will be made by the German dye cartel to break down trade barriers. Nor will the German drive against our tariff be the only one; there are free trade demogogues aplenty on our own soil. We repeat, the vigilance of our dye manufacturers should not be relaxed—should, in fact, be strengthened by every means during the coming months. Earnest co-operation among the various branches of the chemical industry will become increasingly urgent as the tariff fight develops. Let us have more meetings like that held last month under the auspices of the Chemical Advisory Committee for the discussion of this international campaign against tariffs. The admirable understanding thus engendered among the members of the industry will be the most powerful weapon against all adverse influence in tariff matters to which Congress may be exposed in its next session.

Profit of British Dyestuffs Corporation for nine months to December 31, when company was merged into Imperial Chemical Industries, totaled £83,000, against £253,500 for full previous year. Directors state that reduction in earnings was due to coal strikes.

VARIED PROGRAM FOR MEETING OF THE PHILADELPHIA TEXTILE ALUMNI

One of the notable events of the season in textile circles, the Annual Meeting and Cruise of the Alumni Association of the Philadelphia Textile School, has this year been planned with a varied and unusually active two-day program.

The twenty-sixth annual business meeting will open at noon on Thursday, June 2, with a luncheon at the school. Reports of officers and several interesting technical papers will be presented and there will be an election of officers and directors.

The first major event in the annual cruise will be the time run to the Manufacturers Country Club, Oreland, Pa., from the starting point at the school on Broad and Pine Streets, Philadelphia. All owners of cars are eligible whose drivers' registered time of leaving this point is between 9 a. m. and 9.30 a. m., Friday, June 3. An appropriate souvenir of the day will be awarded to the winner.

The second annual Association Handicap Golf Championship will be held at the club. The silver trophy cup remains in possession of the association, the name of the winner being engraved on the cup. Competition is confined to members of the association.

Married and single men will contend on the diamond in the grand Association Baseball Championship Game—one of the merriest of events for both players and ball fans. Prizes will be awarded to the tallest player, shortest man, best pitcher, longest hit, man who came greatest distance, man whose class is the oldest, etc. Luncheon will be served after the game, at 1 p. m. sharp.

After this active day on field, links and highway, all surviving members will jog homeward and gather in the evening at the Manufacturers Club, Broad and Walnut Streets, Philadelphia, for the Twenty-sixth Annual Banquet, which will be served at 7 p. m. Reservations and checks for this notable affair should be in the hands of the committee before noon of June 2. The fee is $5 per person.

The committee in charge of the program of the Twenty-sixth Annual Meeting are: Cruise—William J. Wall, chairman, Henry Legge, Harry Lonsdale, H. C. Aberle and C. W. Neeld, Jr.; Banquet—Willis Fleisher, chairman, William J. Maurer and Charles E. Firth; Resolutions—William C. Robb and Harry Lonsdale; Nominations—William C. Robb and John Lockwood.

The Diamond Silk Dyeing & Finishing Company, West New York, N. J., has taken bids on general contract for a proposed one-story brick addition, estimated to cost $60,000 with equipment. Charles H. Muller, 322 Fifteenth Street, is architect. It is proposed to begin superstructure before the close of the month.

Chlorination and Unshrinkable Wool

Discussion of the Cause of Unshrinkability, and Use of Mordant and Chlorine to Eliminate Faults

"THE discovery of a totally new aspect of the origin of damage to chlorinated wool" and suggestions for improvements in the unshrinkable wool trade are the results of recent research by Speakman and Goodings, of the university at Leeds.

Current explanations for the rendering of wool unshrinkable by treatment with chlorine are that the outer scales of the fiber are either fused down or eaten away, but these are now regarded as incorrect, because the scales are still visible after normal commercial treatment with chlorine.

In getting at the fundamentals of the action, it was observed that chlorine water applied to wool causes the formation of very tenuous blisters around the fiber which can be seen only under the microscope. In themselves these are not of great significance, but they are curious and are evidence of some very definite change in the protein substance of the wool fiber surface.

Cause of the Property

Following the commercial practice of dechlorinating and washing in soap or soda, it was found that immediately on contact with such alkaline solutions the outer fiber layers swell rapidly to form a complete sheath of jelly. The scales are now on the outside of this jelly layer in a more or less undamaged condition. On washing and drying, the fiber goes back to normal size, but rewetting causes swelling to nearly the original degree.

The intervention of this jelly-like layer between the scales and the unchanged fiber core is the cause of unshrinkability. In rubbing, as in laundering or fulling, the scales are not now rigid enough to cause the necessary fiber-travel for shrinkage.

Soap or alkali is, therefore, to be considered a vital part of the process. Acids also cause a similar swelling, and such wool would thus be unshrinkable to acid milling.

The formation of the jelly by the successive action of chlorinating agents and soap causes the bad wearing quality in some of the wools so treated, because the other scales and this soft layer are readily worn away. It also explains the slimy feel of overchlored wool.

Use of Chrome Mordant and Chlorine

The faults of unshrinkable wool can be avoided by a process of causing the jelly layer formed in soap or soda to shrink to the unattacked part of the fiber and harden. It was found that chrome mordanting, preferably after the mild alkaline treatment, had the desired effect. Chrome dyes, therefore, are particularly suitable for such wool, as it remains unshrinkable, while the mordant protects the wearing qualities.

In another type of experiment it was determined that a few tenths of a per cent of chlorine produce little or no effect; then there is a period of rapid increase in action as more chlorine is used; and finally a slowing down, where the effect is not in proportion as additional amounts are used, and where the wool is becoming overtreated. This is partly a function of penetration of the goods, the outside becoming too strongly attacked before the inside fibers are affected. It was considered that the results so far obtained did not justify statements as to the amount of chlorine required to produce absolute unshrinkability; but basing the amount on pure chlorine, applied as chlorine water, the main part of the action was approximately complete at 2 per cent or a little over.

TIZRA WOOD AS SOURCE OF TANNIN

The Tizra wood from the Mogador district, Morocco, has the reputation of containing the greatest amount of tannin, but recent analyses made of wood from other districts show about the same percentage. Exports for 1925 were: France, 3,683,500 kilos; Germany, 818,000 kilos; Spain, 1,494,835 kilos; Italy, 4,386,500 kilos. A short report and list of exporters are available on application to the Chemical Division of the Department of Commerce.

GERMAN DYE TRUST DEVELOPS NEW TANNING MATERIAL

New avenues for wider utilization of wood charcoal may be opened by successful operation of a recent patent taken out by I. G. Farbenindustrie A. G. calculated to produce a tanning material not only effective as such but capable of improving the efficiency of other tanning materials. This development may lessen imports into Germany of tanning materials from abroad. According to this patent, says "Deutscher Fortswirt," of Berlin, finely divided wood charcoal with 14.8 per cent oxygen content is stirred in water, treated with 95 per cent nitric acid and slowly heated to boiling. After twelve hours cooking, the greater part of the liquid is distilled off, 95 per cent nitric acid is slowly added again, and this is heated for two days to weak boiling when almost all the hydrous HNO_3 is distilled off, finally in a vacuum. After repeated evaporation to a dry state the residue is powdered. This is an orange to yellowish product that is completely soluble in water.

The neutralized tanning materials, according to the Department of Commerce report, is said not only to prevent too great a swelling of the hides, but hastens the process of tanning with better penetration and makes the hide color lighter. If soda ash is added to a hydrous 20 per cent solution of the tanning material and well delimed (and dehaired) hides are introduced into this, soft leather

of reddish brown color is produced in from eight to ten days. If the solution, neutralized with soda ash, is mixed with chestnut wood extract and then diluted with water, it produces within 10 to 14 days a clear brown full leather.

Hand-Made Shade Cloth

A Craft Whose Methods Might Be Further Advanced —Processing of Shade Muslin Has Its Peculiar Problems

By O. A. Fritz

President, Crystal Shade & Screen Company

In this age of rapid progress and invention in all mechanical arts, many important hand arts have been entirely neglected or have developed but slowly in comparison. After all, the word "manufacture" means literally "to make by hand." If a day should ever come when a standardized and mechanized America loses all appreciation of the worth of hand-made goods we can expect a decadence of our artistic spirit.

Hand-made window shade cloth should be considered as a decorative material as well as a highly useful product. It possesses certain marked advantages over the machine-made type, and when properly constructed is extremely durable as well as beautiful. Very little advancement has been made in its manufacture, however, the methods of framing, sizing and painting being similar among its makers. But there is always the human element to be considered, as with any hand-made product, and it is good workmanship which, in the final analysis, distinguishes the superior from the inferior.

The process of manufacturing hand-made shade cloth, notwithstanding its simplicity, largely depends on this element of craftsmanship and on the quality of the materials employed. The muslin used must be of the very finest texture, evenly woven and smooth, to prevent "spotty" effects when the size and paint are applied. It is glued on frames and slightly stretched by hand, and in the case of Velmo cloth, sized with a specially-prepared black size, after which it is again hand-stretched and the frames shifted so that the next sheet can be similarly treated.

It is obvious, of course, that the sizing compound used must have good body to it and a certain softening property in order that it can be applied evenly over the surface of the muslin and impart to it a certain stiffness, without, however, destroying the soft feel and appearance of the cloth. A size containing any ingredients of a hydroscopic nature would be unsuitable, since on exposure to the air the cloth would dry and stiffen. The size is spread on with extreme care to prevent clotting, which would later result in uneven distribution of the paint. Any defects of processing are revealed when the cloth is hung in the light of the window. It is here that the element of expert craftsmanship has its influence in producing the perfect product.

Considerable time must elapse between these operations, first to allow the glue, which attaches the cloth to the frame, to set, and then to allow the sizing to set preparatory to painting. Further shifting of the frames continues, as one side of the cloth is painted, and then additional time is allowed for drying, after which further painting may be necessary.

The finisher accustomed to employing machinery for almost every operation in the processing of his cloth can easily understand why the manufacture of hand-made shade cloth is both costly and somewhat slow. The final product, however, would seem to justify the time and trouble entailed in its manufacture. As in any other department of textile manufacture, special problems arise and call for special knowledge and means of solving them. For example, the three thousand window shades in the new Hotel Statler, in Boston, which we recently equipped, had to be of a gumwood tone color, and yet be absolutely opaque. The requirements, in other words, were not the same as for shades for an ordinary dwelling

The time may come when the process of making shade cloth by hand will be developed to a point where production can be materially increased and costs considerably reduced. It offers a problem that may yet be solved by the combined ingenuity of the textile chemist and finisher and the textile engineer.

ALLEGED DISCOVERY FOR PRODUCING INORGANIC ACIDS

Two French chemists report that they have acquired exclusive rights to new formulae for producing formic, oxalic, lactic and ethyl lactate. It is claimed that the three acids produced by their process can be sold at 5 francs per kilo with a profit of 30 per cent and that ethyl lactate can be produced for sale at 30 francs per kilo with a profit of 20 francs. The present approximate value of the franc is $0.0391. The names of the French chemists are available to interested American firms by request to the Chemical Division, Bureau of Foreign and Domestic Commerce, Washinton, D. C. The Bureau has not investigated the alleged discoveries and cannot assume any responsibility as to their commercial value, or express an opinion of the merits of the method.

I. G. PLANS TO BUILD PLANT IN LOUISIANA?

The German dye trust has invested in some American property and perhaps is planning the erection of a plan within our very borders. At least word has been received by way of the Department of Commerce that incorporation papers have been filed in the State of Louisiana by the I. G., with a view to the erection of a works at Monroe, La., which is located in natural gas fields.

Just what the dye cartel may have in mind is not known to the Department of Commerce officials, who would like further light on the matter. It is known that a group of German chemical experts visited that section of Louisiana some months ago.

Technical Notes from Foreign Sources

Aniline Black Dyeing

In dyeing or printing fibers or fibrous material, whether of animal, vegetable or artificial origin, the fibers are treated with a mixture comprising a free amine, water and a water-soluble solubilizing or emulsifying agent, the amine being subsequently oxidized. Suitable solubilizing or emulsifying agents are aromatic sulphonic acids, preferably substituted by alkyl, aralkyl, aryl or hydroaryl radicles, with or without other substituents, salts of such acids, soaps, Turkey Red oil or organic solvent. Protective colloids may also be present.

The amines are dissolved or dispersed in water by means of the solubilizing or emulsifying agents, and the materials, whether in the form of loose fibers, yarn or fabrics, are then impregnated with the solutions or dispersions. The method may also be employed in discharge or resist process.

In an example, yarn is impregnated with aniline dissolved in a solution of the sodium salt of di-isopropylnaphthalene-sulphonic acid or normal dibutylanilinesulphonic acid and then subjected to an oxidizing treatment. Potassium bichromate and sulphuric acid may also be added to the solution, or the solution may be mixed with a thickening and an oxidizing agent, and, if desired, a catalyst promoting oxidation, and the product employed in printing. (British Patent No. 262,476.)

The Retting of Jute

The development of dust in the processing of the jute was greatest in the case of the unsprinkled fibers, and somewhat less in the case of the raw jute which is treated with water, while in the case where the jute was wetted down with oils and train oil, there was scarcely any development of dust at all. This led to the conclusion that the fibers, when worked up in the dry condition, are materially injured, while train oil, as well as other oils, improve the appearance of the fibers. This fact was corroborated by the determination of the tearing length of the fibers which was approximately 20 per cent greater for those that had been wetted down than for those that had been treated in the dry state, the number of twists in the fiber being the same in both cases. The use of train oil is also important from the standpoint of the structure of the fiber. This same condition holds good with respect to the smoothness of the thread and the luster and appearance of the spun material, all of which are improved by the use of train oil. In using a mixture of train oil, mineral oil and water, the latter two substances are only of minor importance as compared with the first.

It was also found that when the jute was not first wetted down with water, train oil or other oils, the product obtained from it was very dull in color, rough, very irregular and full of many thick spots. Sprinkling with water gives a better grade of yarn and a better appearing fiber. Nevertheless, water does not exert a very important influence on the goods or on the processing thereof, for the spun materials show scarcely any different character than the original.

The same is true when mineral oil is used for impregnating the jute fibers before they are processed. The outward appearance of the fibers is only improved and the tearing length of the material is increased. The mineral oil tends to darken the color of the jute. The oil has no effect on the smoothness and luster of the fibers.

The mineral, impregnated with train oil, gave better results. Scarcely any dust at all was developed in the machines and the quality of the fiber was materially improved. The strength of the fibers is also increased. The yarn was lustrous, smooth and uniform. The number of thin spots was very small, while there were scarcely any thick spots. The color of the yarn was somewhat darker than the rest of the spun material. The use of a mixture of water, train oil and mineral oil for retting jute gave the same results as train oil alone. The fact that the best results are obtained with the mixture is due to the fact that the train oil is most effectively distributed. (Melliand's Textilberichte, 1927, page 239.)

Ice Color Process

Improved fastness to rubbing is obtained in ice colors by treating the impregnated material, with or without previous centrifuging, pressing or draining, with a weaker impregnating solution to which sodium hydroxide and an electrolyte have been added, or with a solution of an electrolyte which contains a little sodium hydroxide, or with dilute sodium hydroxide solution alone. In all cases formaldehyde may or may not be present in the liquor. The process is applicable to ice colors which are made from 2:3-hydroxynaphthoyl or acetoacetyl derivatives of arylamines and arylenediamines. (German Patent No. 433,149.)

Developing Salts in Dyeing

In the preparation of anhydrous mixtures which contain a nitrite and the mineral acid salts of aromatic amines capable of yielding a diazo solution when dissolved in water, the mineral acid salts are replaced by normal-sulphonic acid derivatives of diazotizable amines (according to German Patent No. 431,150) and salts other than mineral acid salts of diazotizable amines (according to German Patent No. 433,151). A satisfactory developing mixture comprises, in the first case, Glauber salt, sodium bisulphate, sodium nitrite and the sodium salt of a naphthalene-sulphoamino compound, or, in the second case, acid aniline

oxalate (or aniline salts of phthalic or aromatic sulphonic acids; for example, benzene-sulphonic acid), Glauber salt, oxalic acid and sodium nitrite.

Structure and Strength of Aerated Rayons

Hollow viscose rayon fibers, which are produced by squirting viscose solutions which are aerated or contain substances which are capable of liberating carbon dioxide or other suitable gas during coagulation in an acid bath, are less dense than normal solid viscose fibers and, owing to peculiar reflection of light from both cuticle and lumen, they have greater covering power when present in textile materials. During processes of production, the air within the tubular fibers is displaced so that they collapse to a ribbon-like form somewhat resembling that of cotton. The various English, French and German varieties of hollow fibers examined were of four to five deniers and had average breaking strains of 1.52, 1.57 and 1.01 grams per denier, respectively, in the dry condition. When moistened they suffered a loss in tensile strength of 68.4 per cent, 66.9 per cent and 69.9 per cent, respectively (corresponding to a loss of 68 per cent for similar solid fibers). The extensions at breaking point of hollow fibers were 15 to 19 per cent in the dry condition and 15 to 20 per cent in the wet condition. These are greater than the corresponding extensions of 13.8 per cent in the dry condition and 15 per cent in the wet condition of the solid fiber. (Kunstseide, Vol. 8, pp. 397-401.)

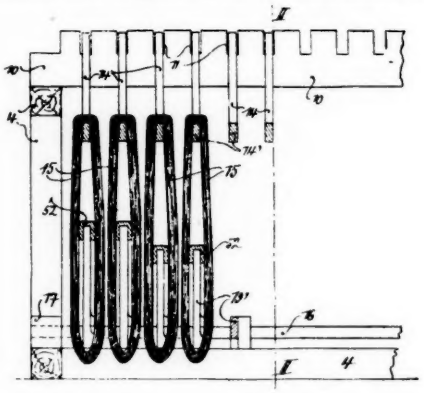
New Process for Using Chrome Colors on Wool and Silk

The purpose of the new process is to obtain dyeings on the fabric which are fast to washing with soap. Chrome colors which dye slightly chlorinated wool are preferred for this purpose. The silk, which is printed with a fatty reserve composition, is dyed in the cold in the presence of a little acetic acid. The subsequent chroming, followed generally by a change in shade, is not carried out as usual in the open bath and with prolonged boiling, but the fabric is placed in a solution of 1 to 2½ per cent dichromate to which a little acetic acid has been added, and is then steamed for a period of two to twenty minutes. The steaming leaves the fiber in much better condition than when it is treated in the open bath, which is very harmful to silk. When this fiber is being treated, the steaming must be reduced in time as far as possible.

The reddish-brown colors that are obtained after cold dyeing with Eriochrome Azurol B (Geigy) change to a marine blue after steaming. Bordeaux shades, which are obtained by dyeing in the cold with the aid of Diamond Black PV, become black after similar treatment. The process can also be applied to Dauphin Blue B, Alizarine Yellow GG and R, and Alizarine Saphirol. It is a very interesting process from the standpoint of the fatty reserve composition, and the short steaming does not injure the reserve and the color obtained possesses high fastness to soaping. (Bulletin de la Societe Industrielle de Mulhouse, Feb., 1927, pp. 124-5.)

Dyeing Skeins with Circulating Dye Liquor

In dyeing skeins that are hung from rods by means of a circulating dye liquor, the difficulty has been found that the hanging skeins are not introduced smoothly into the dyeing apparatus but get caught in one way or another. This condition is avoided by means of the arrangement shown in the accompanying illustration. The lower rods which hold the skeins are brought up only to the center of the total width of the skein and a guide rod is introduced into the



series of hanging skeins and placed on the carrying arm.

The carrying rods shown at 52 are made in the U form from metal, the opening of the U shape being toward the bottom, and are introduced between each pair of lower holding arms 19^1 lying opposite to one another. In order to facilitate the introduction of the carrying rod 52 in the hung skein, the upper carrying rods 14 may be provided with a groove on the under side. The front top end of the rod 52 is led into this. (German Patent No. 436,512.)

Dyeing Rayon with Logwood

Viscose and cellulose acetate rayons are dyed in black shades by treatment with an aqueous solution of logwood, and then afterchromed, both fibers having a substantive affinity for logwood. Viscose silk may be dyed cold, whereas cellulose acetate rayon requires the dye bath to be maintained at a temperature of 60 to 80 deg. Cent. For example, cellulose acetate rayon is immersed in a 2 to 5 per cent solution of logwood at 70 to 80 deg. Cent. for fifteen to thirty minutes, whereby it acquires a light orange to dark brown shade, and is then developed in a 1 to 3 per cent solution of sodium dichromate at 60 deg. Cent. for ten to thirty minutes. (British Patent No. 263,222.)

RECENT LITERATURE

Processing as a Mechanical Science

Textile Bleaching, Dyeing, Printing and Finishing Machinery. By A. J. Hall, B. S., F. I. C. 320 pages; 365 illustrations. $14.00. D. Van Nostrand Company, New York.

The modern bleacher and dyer must be a machinist as well as a chemist, and should be equally competent in both callings, for the processing of textiles has developed into a mechanical as well as a chemical science. This lusty volume, ambitiously broad in scope and with text copiously illustrated with interesting photographs and diagrams, should make good reading for the mill man who would know more about the construction and operation of the various types of machinery he uses in processing.

Almost any reader will find parts of the book with which he is fairly familiar; in his daily work he has doubtless employed many of the machines described. But even from these parts he will learn many new things. The contents deal with so many different classes of machinery for dyeing, bleaching, finishing and printing, and so many different types of equipment within each class, that the book cannot but be instructive to the average mill worker who desires knowledge of processing machinery outside the range of his own experience. As the book is the work of a British author, only English and European machinery is described—a fact that may count against the book's popularity with American readers.

The illustrations take up at least one-half of the page space and are with few exceptions well done. A number of excellent diagrams supplement the two hundred or more photographs and show clearly portions of the mechanism not seen in the latter.

The first part of the book deals with machinery for fabric processing; the second with yarn processing machinery and the third with equipment for bleaching, dyeing and finishing knit goods and loose fibers.

Research Methods

How to Do Research Work. By W. C. Schluter. Prentice-Hall, New York. $1.25.

When the research chemist, either industrial or pure science, has selected a subject which he believes worthy of thorough investigation, his primary problem is how to go about collecting the data he will need for his conclusions and how to arrange that data when he has assembled it. This little volume is a treatise on the procedure that should be followed, from the collection of data to the final publication of the results. The arrangement of data, the elimination of the useless and the classification of the essential; the employment of statistical devices and the interpretation of data—these are some of the interesting topics discussed.

On Starches

Starch Making and the Manufacture of Dextrin, Starch Sugar, Syrup and Sugar Coloring. By Felix Rehwald. Fifth edition, revised. 272 pages. Illustrated. $5.00. D. Van Nostrand Company.

A handbook for starch, dextrin and starch-sugar manufacturers, translated from the German by Charles Salter.

Lowell Textile

Bulletin of the Lowell Textile School—1927. Illustrated. 82 pages.

Complete information for the guidance of prospective students of textile manufacturing. The contents of this annual bulletin include sections on the history and objects of the school, a statement of entrance requirements and full general information about the institution's facilities. All course and subjects of instruction are explained in detail and descriptions are given of the school buildings, grounds and equipment.

Pyrex Industrial Glass Products.

An illustrated catalog issued by the Industrial Equipment Division of the Corning Glass Works, with brief text explaining the properties of pyrex and picturing a number of pieces of equipment for industrial laboratory work.

Bulletin of Development Covering the Year Ended June, 1926. 31 pages. Sales and Research Department of Adam Hilger, Ltd., London.

A catalog and bibliography describing new developments in optical instruments for use in spectrophotometry, colorimetry and X-ray studies and listing a number of articles that have recently appeared in British scientific journals on the uses of such instruments in the study of emission spectra, mercury spectra, excitation and critical potentials and similar phases of spectrophotometry.

A little booklet on velvets, their history and utility, was recently distributed to stockholders of Collins & Aikman Company. It is illustrated with colored plates showing ancient and modern designs on velvets.

Under a new ruling this year a charge of $1 per year is made for the monthly import lists of the Department of Commerce. These consist of the "Dye List," which covers the imports under Paragraphs 1, 5, 23, 24, 27, 28 and 61; "Chemicals and Allied Products Entered for Consumption," which includes chemicals

not entered in the above paragraphs, and the single mimeographed sheets giving the total monthly imports of a commodity by countries. As these have heretofore been distributed gratis, it will be necessary to advise the Department of such lists as are desired, sending subscription with remittance to the Superintendent of Documents, Government Printing Office, Washington, D. C.

STATE COLLEGE SUMMER SCHOOL OFFERS COURSES IN TEXTILES

The summer session of the North Carolina State College will open June 12 and continue for six weeks. The Textile School will offer intensive courses in mill calculations, carding, spinning, weaving, designing, fabric analysis and dyeing. These courses will be taught by the regular members of the Textile School Faculty and have been so arranged that a mill man may attend two, four or six weeks and devote his entire time to any particular branch or branches of the industry in which he is especially interested. This will be an excellent opportunity for mill men and teachers of night classes for mill operatives to supplement their practical training with a theoretical knowledge of the industry.

The Textile School also offers a special course for teachers in textile communities. This course will be as nontechnical as possible and designed to give the teachers a general knowledge of textiles.

A course in cotton classing, offered by the Department of Agronomy, deals principally with practice in grading and stapling cotton. Each man is expected to grade and staple seventy-five to one hundred samples during the class period each day. The course is accompanied by short lectures, demonstrations and pictures. The universal cotton grades will be used as the basis of the course, and practice samples will cover the entire number of Government grades.

The Textile School and the Department of Agronomy have arranged their courses so that a mill man may spend his mornings in the Cotton Classing course and his afternoons in the Textile School persuing any course or courses he may select, or he may spend only a part of the morning period in the Cotton Classing course and the other time in the Textile School.

Those interested in the textile courses should write to Dean Thomas Nelson, State College Station, Raleigh, N. C. Those interested in the Cotton Classing course should write Prof. J. B. Cotner, State College Station, Raleigh, N. C.

Thomas J. O'Connell, who was formerly dyer and bleacher at the Suffolk Knitting Mills at Newton, Mass., in charge of the Rayon Department, and previously with other knitting mills in New York State, has become associated with the Boston office of the American Aniline Products Company, and will represent them in this territory.

C. W. Gunter, a graduate of the North Carolina Textile School, has been appointed Superintendent of Dyeing and Finishing at the Mooresville Cotton Mills, Mooresville, North Carolina.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i. e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

COTTON DYER

Wanted—Cotton dyer, thoroughly experienced with sulphur and indanthrene colors on Brantwood, Franklin and Delahunty machines. Address Classified Box 390, American Dyestuff Reporter.

DYER WANTED

A California dyeing plant, the only one of its kind on the Coast, needs a dyer who understands the dyeing and finishing of new materials, as well as redyeing and converting for resale. He should be able to take full charge, secure results and grow with the business. An unusual opportunity. Address Classified Box 391, American Dyestuff Reporter.

DYE CHEMIST

Wanted—Young chemist by well-established firm of dyestuff manufacturers. Must be college graduate. Good opportunity for ambitious man. Address Box 392, American Dyestuff Reporter.

DEMONSTRATOR

A large manufacturer desires to secure the services of a man thoroughly familiar with all phases of textile processing to supervise the introduction of several unusual textile specialties. Good initial salary and an excellent future for the right man. Address Classified Box 393, American Dyestuff Reporter.

SALESMAN

One of the large factors in both imported and domestic dyestuffs seeks the services of an additional salesman for New England territory. The applicant should be young, well educated and possessed of some technical knowledge. Address Classified Box 394, American Dyestuff Reporter.

OVERSEER OF DYEING

A man who has had charge of cotton piece goods dyeing, bleaching, mercerizing and finishing at some of the leading bleacheries of the country desires a similar position. Thoroughly familiar with all classes of cotton dyeing (including vats) in all types of machines. Best of references. Address Classified Box 395, American Dyestuff Reporter.